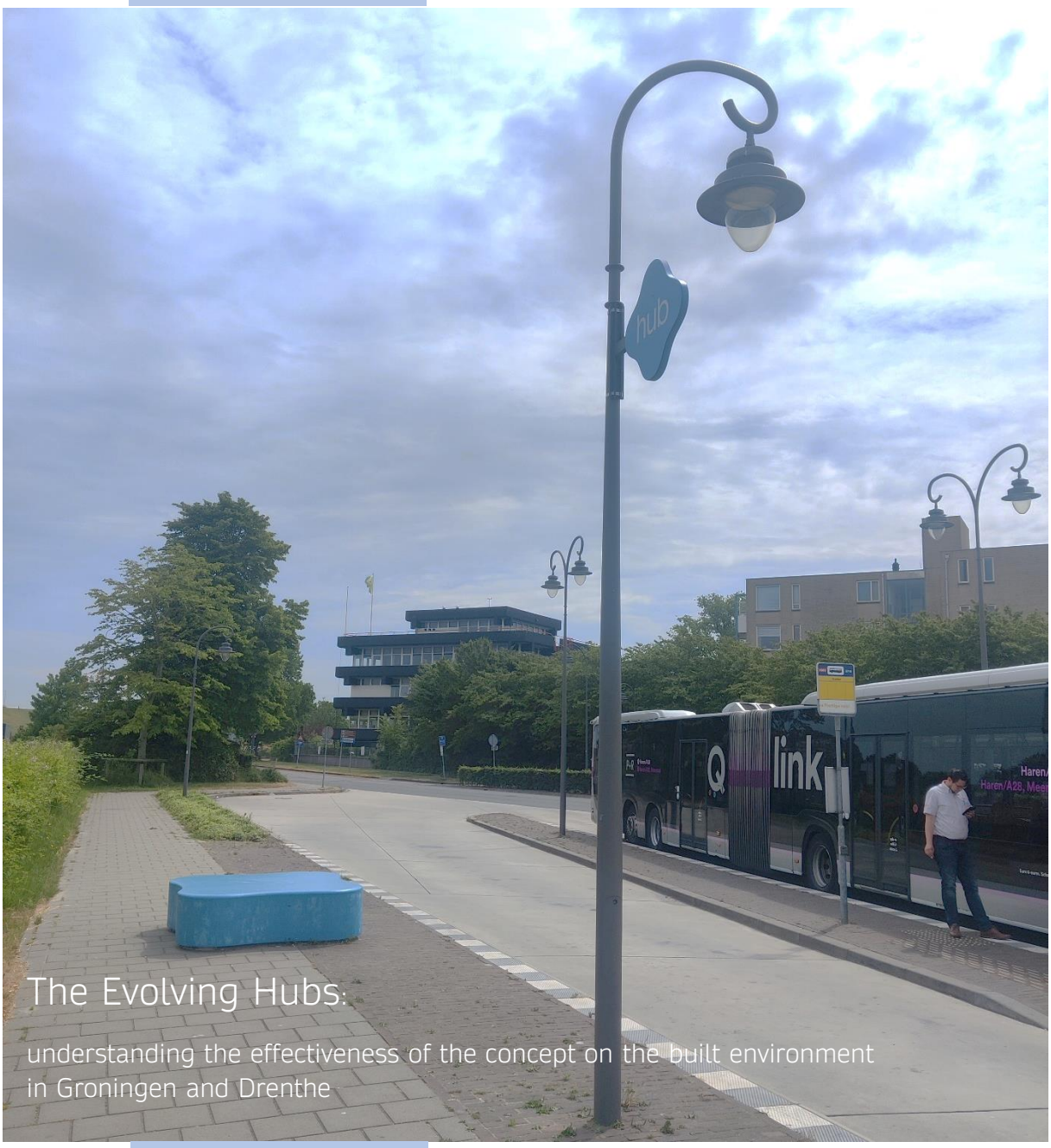

The Evolving Hubs:

understanding the effectiveness of the concept on the built environment in Groningen and Drenthe

Nigel Onwuachu

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Colophon

Title: The evolving Hubs: understanding the effectiveness of the concept on the built environment in Groningen and Drenthe

Author: Nigel Obioha Onwuachu

Student-ID: s3421716

e-mailadres: n.o.onwuachu@student.rug.nl

Supervisor: dr. Ir. Terry van Dijk

First examiner: dr. Ir. Terry van Dijk

Educational organisation: Rijksuniversiteit Groningen – Faculty of Spatial Sciences

Program: Society, Sustainability & Planning

Abstract

Selected transportation nodes have been upgraded in the Dutch provinces of Groningen and Drenthe with the goal to improve accessibility for rural inhabitants. These so-called 'Hubs' are designated places where transfers are facilitated to different modalities in a comfortable and attractive manner. The concept of Hub is developing over time into a concept that not only concerns with rural mobility, but also enters the domains of other policy such as accessibility, sustainability and equity. The question remains whether Hub is a useful tool to fulfil this policy and how that can be measured. The purpose of this thesis is therefore to understand the complex nature of the policy domains Hub is involved with, through an effect evaluation. Five Hubs were analysed based on changes in the built environment on three different levels of scale and changes in accessibility over a timespan of six years. The results show that no significant changes have emerged between the six years that have been analysed. Explanations for this can be found in the rural nature of the surroundings, and the little time period that was used for the comparison. Also the lack of data qualitative data available from 2016 made it difficult to draw comparisons on how the Hub-concept added onto the transit node. As these point of views are very important for the concept to embed properly in its surroundings, it is recommended to incorporate the local communities more into the place-making for the Hub. By incorporating these groups, a possible effect can be traced more effectively.

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1. INTRODUCTION

Investment in regional accessibility has been a point of attention for both the provinces of Groningen and Drenthe. The focus was laid on providing sustainable mobility accessible for all citizens of both provinces, where the usage of public transportation is encouraged. Therefore, the public transportation network had to be restructured to achieve the following goals: to become more resilient for future travel demands, while also becoming a more attractive travel alternative for a part of the population that, at the time, did not consider taking the bus.

1.1 Network changes

This new structure of bus services in Groningen and Drenthe prioritized buses with a relatively high average speed that connect big nodes, while offering high service frequencies; Q-link and Q-liners. In this new network, slower, more local bus services would connect with these quicker, regional services at transfer stations, which would be referred to as a *Hub*. Having passengers transfer via these hubs had numerous benefits, as stated in *HUB, meer dan overstappen* (2017): operational benefits for the bus operator, as proper investments in locating Hubs could speed up travel times of buses. These measures would result simultaneously in lower operating costs and enhance the attractiveness of the bus service for passengers travelling through the Hub. For example, a passenger travelling from Emmen to Groningen will not have to travel through the village of *Gieten* anymore, but rather make a short stop at HUB *Gieten*, which is located on the border of the village and along the highway, resulting in a more comfortable and faster journey. Other stated benefits would be the expected cost reductions for transporting those with special needs and the enhanced attractiveness for inhabitants to make multimodal journeys, which in turn fits in with policy ambitions set out by both provinces; to create a more accessible transportation network for everyone.

Hubs are a hot-topic in the Dutch world of transportation. Multiple studies and policy papers concerning mobility have since used the term to describe a node in a network, albeit either for BRT (Bus Rapid Transit) proposals along a highway corridor in the Mid-South of the Netherlands (Ministerie van Infrastructuur en Waterstaat, 2022), or in the Mid-West (Van Slooten and Kuijper, 2020), or even as part of an urban redevelopment proposal in the city of Haarlem (Gemeente Haarlem, 2023). This widespread and frequent use of the term leads to somehow confusing definitions of what a hub entails. Where one local institution sticks to the conventional public transportation hub, another includes more different forms of mobility, and aim to go even further, such as the provinces of Groningen and Drenthe. These institutions, and those affiliated such as the *OV-bureau Groningen Drenthe*, seem to be ahead in what they believe a hub can offer for society more than just mobility; branding it a destination rather than a necessary part of your journey.

1.2 Relevance

Ambitions are set to keep reinventing the Hub concept in Groningen and Drenthe. Annually so-called "HUB development days" are organised in which different parties come together and start brainstorming about the future of HUB. What started as a network of small public transportation hubs, turned into a project that encompasses all different kinds of mobility. During such a development day, it became apparent that the next step in the development of HUB is to create an even more inclusive network of HUB. This inclusivity goes beyond mobility and expands into territories of social and cultural capital. Examples mentioned include day-cares, medical services, and libraries, among others. This would require functions to be relocated to or near the HUB. At the time of writing this, the library in the village of Roden is being rebuilt into to accommodate more of a social function that it already had been, with its entrance facing the regional HUB of Roden when completed (reisviahub.nl, 2021). Examples of developments like these demonstrate the possibilities for the Hub concept to cooperate with its direct, spatial surroundings. This cooperation is believed to result in a space that will be more attractive for people to visit. The high service level of mobility combined with the greater social and cultural function are believed to reinforce one another.

1.3 The possibilities through Hub

There is this focus on multimodality and Hubs that could lead to interesting technological innovations. Due to the interdisciplinary nature of Hubs these innovations can be very different. Take for example the possible use of autonomous vehicles to transport passengers across the last mile from a Hub. Such a bus ran trial in *Scheemda* between a hospital and a nearby bus stop, which were 1.5 kilometre apart (Provincie Groningen, 2022).

Hub could support policy goals intended to solve pressing issues, such as the nitrogen crisis that directly affects the housing (affordability) crisis throughout the Netherlands. The region of Groningen and Assen alliance (RGA) has projected that an average of 25.000 houses needed to be built between 2018 and 2030 to cope with demand (RGA, 2017). The RGA (2017) concluded that the most demand for housing would be within city limits of Groningen, while stating that that number simply is not feasible within the set timeframe. Regional Hubs with great connectivity to the city of Groningen could alleviate the pressure and lead people into the region and vice versa. The Hubs would then build bridges between the city and rural villages. The Hub-program manager *Martin Courtz* stated during the HUB-development day the wish to create housing nearby HUBS to ultimately convince those living near one that they do not need to own a car to get around for their daily needs and wishes. Through enhancements in the area of influence of a Hub, one would be motivated to use more active transportation methods to get around.

However, can this motivation also carry notions of force? Over the past decades rural areas have seen a reduction in bus services as a result of lower passenger numbers. Multiple reasons could be addressed for this reduction, such as increased competition of other transport modalities (car, (e-)bike)), the overall

decline of the population in rural communities and the reduced subsidies the government provides for public transportation. The accessibility of public transportation has already steadily declined to a point where one should question: can a Hub stabilize this reduction? Some Hubs can be located far outside of regional cores, isolated from hearts of communities; are people willing to cross this distance before making use of public transportation or does that push one more to make use of their car? This contradicts the institutions' ambitions to stimulate active transportation methods among its inhabitants. It is evident that there is some sort of relationship between Hub investment and investment in spatial development, but how does one define that relationship?

1.4 Purpose

The purpose of this thesis is to understand what potential effect investment in a Hub network has on the spatial development (in-)directly surrounding it. Understanding the relationship between these two entities could rethink how governmental institutions accomplish determined policy goals for mobility in rural areas. The policy goals recognized in this context include, among others, the ambitions to create a healthier population, a better accessible rural population, and an increase in people using sustainable transportation methods.

By attempting an effect evaluation of the HUB-network in Groningen Drenthe, which has been among one of the longest-existing networks in the country, clarity could be made concerning the effectiveness of Hubs within a greater spatial context. Since large parts of infrastructure have already been delivered, such an evaluation would therefore be more of an ex-post nature rather than ex-ante, though still carrying elements of the latter as the concept is in constant evolution. Nonetheless, ex-post evaluations are carried out far less frequently than ex-ante evaluations, often due to policies not in place for such (De Jong et al, 2020). On top of this, the scientific literature that is available at the time of writing this thesis is mainly centred on Hubs in urban settings. There is still a lot unknown about the usefulness of Hubs in a rural context. This thesis strives therefore to establish a better understanding of such.

1.5 Research Questions

The following research question has been posed with a set of sub-questions following.:

> RQ: What is the relationship between Hub investments and the spatial development within a Hub's area of influence?

Sub-questions:

> SQ1: What were the initial goals and expectations by policymakers that justified investment for the Hub concept?
>
> SQ2: To what extent does scientific literature on Hubs in an urban context relate to Hubs in rural surroundings?

SQ3: What spatial changes have occurred within the area of influence of Hubs?

SQ4: What improvements have been made concerning the accessibility of Hubs?

1.6 Hypothesis

It is to be expected that the relationship between Hub and spatial development is quite weak. This is due to the relative short time for the concept to evolve and transcend into a concept being concerned with more than mobility. However, the concept seems to have potential to help (local) governments solve pressing issues, such as the shortage of housing availability and an aging rural population.

1.7 Scope of the research

The scope of this research encompass the rural communities of Groningen and Drenthe and the extent of which their surroundings are subjective to changes in the built environment as a result of the Hub-concept. This includes concepts such as accessibility and different affiliate elements, but also the discussion of a model that concerns the place-making of a transit node, such as the NPE-model, and also the concepts introduced in policy documents by relevant governmental institutions. The research will be structured around five Hubs that serve rural cores in the provinces of Groningen and Drenthe. Findings and qualitative data from 2022 will be compared to quantitative data known about these Hubs from 2016.

1.8 Structure of the research

Firstly, a literature review will be done to understand how Hubs are defined in scientific literature, which will be extended by a definition of congruent concepts that are derived from the literature. Secondly, the Hub-concept specifically for Groningen and Drenthe will be discussed and explained. This will be done through an analysis of policy documents that are published by all relevant governmental institutions. These will be discussed along overarching concepts that were found in these documents. These two steps will help the assessment of the answers for sub-questions one and two. Thirdly, a spatial analysis will be performed on a selected number of Hubs in the region, combined with a discussion on primary qualitative and secondary quantitative data. This will construct an assessment for each Hub's previous and current state to clarify the possible differences that have emerged over the course of time. These findings will provide an answer for sub-questions three and four. This research will be concluded with a discussion on the findings, which in turn will provide an answer for sub-question five. With the answers on these sub-questions, it is believed that an understanding can be found of the relationship between Hub investments and (in-)direct spatial development.

2. LITERATURE

2.1 Hubs in literature

The following chapter will elaborate further on how a hub has been defined in literature. Its presence in national and regional policy will be discussed, whereafter the concept of Hub in Groningen and Drenthe specifically will be set out. This will be amplified by discussing elements that form the base of this specific concept, which include the network of Hubs, the facilities provided, the different types of bus services that are present, and the branding of the Hub.

2.1.1 Defining Hubs

Hubs can be defined as ‘’*a type of facility located in a network in such a manner, so as to provide a switching point for flows between other interacting modes"* (Fotheringham and O’Kelly, 1989, P.171). This definition can be derived when one puts ‘’hub’’ in a context where entities interact within a certain space. However, the word “hub” is used as well in other contexts. For example, in computer science a network refers to a group of computers being linked together via servers digitally. An engineer on the other hand would rather suggest a more mechanical approach to a network, for example the spokes in a wheel.

A transport planner would rather expand on the notion of Fotheringham and O’Kelly (1989) and define a hub as; a physical space where activities can be clustered, and multimodal mobility becomes centralized (Yatskiv and Budilovich, 2016). These definitions used by Fotheringham and O’Kelly are rather neutral and describe the literal function of a hub in a spatial context. In contrast, Chauhan et al. (2021) took note of the definition posed by the Madrid Regional Transport Authority in 1985: “An area whose purpose is to minimize the inevitable sensation of having to change from one mode of transportation to another and efficiently using the inevitable waiting time”. This definition carries a certain assumption that hubs are there to make your journey a bit better at the worst element of a passenger’s journey; transferring (Peek and Van Hagen, 2002).

The scale on which these hubs can take place differs from each other as well, while at the same time the same place can accommodate multiple functions. Schiphol acts as a hub in an international network of commercial airline companies (van Boxtel and Huys, 2005) and at the same time Schiphol houses one of the biggest hubs in the national rail system of the Netherlands, residing in the top 5 stations with the most passengers in 2019 (NS Jaarverslag 2019). Located in the same space, however, different functions are operated on different scales. Even as a whole, Schiphol can be seen as a single hub, where different modalities of transportation come together and cooperate.

Bell (2019) performed more extensive research on different hubs, their intermodal connectivity and how these can be differentiated from one another Each of these hubs has their own function within their area of influence. An ‘area of influence’ differs for each separately and are determined for each differently.

On top of this, the specific needs of visitors had been identified for each of the four hubs. The following hubs were identified:

- (1) Urban center hub; a space where different networks come together and interact. The commuter from the region connects with the tourist that aims to explore cultural hotspots.
- (2) suburban hub; designed for commuters who aim to reach an urban center hub, like gateways to the city.
- (3) regional hub; characterized by park-and-ride facilities. In transportation literature, these hubs can be seen as spaces where commuters centralize to enter the stream to the urban areas.
- (4) basic hub; a central location in a village where travelers reach public transportation on foot or by bike.

2.1.2 Ontwikkelagenda Toekomstbeeld OV

The *Ontwikkelagenda Toekomstbeeld OV 2040* is a national policy document which extrapolates steps necessary for a sustainable network of public transportation that contributes positively to the living standards in the Netherlands. This policy document includes multiple mentions of what a Hub in the sense of mobility means and what their role is envisioned to be in the future of Dutch mobility.

A Hub is envisioned to be the " [essential] link in chain mobility, and a place to meet" (Ontwikkelagenda Toekomstbeeld OV, 2021); p.19). The Ministry of Infrastructure and Water Management emphasizes greatly on this concept *chain mobility*, which aims to create a 'smarter' public transportation network that cooperates with multiple technologies and innovations to provide journeys that match the demand for each part of a trip (Ontwikkelagenda Toekomstbeeld OV (2021). Examples of such innovations are on-demand public transportation services that require passengers to request a trip via a smarthphone. This is believed to save the costs of running a regular and infrequent bus service, when the demand is not there. Furthermore, the document states that the ministry believes that stimulating people to use different modes of transportation will solve mobility issues in regions growing in population size. Hubs outside of the big cities, which are served by BRT routes, are mentioned to be: "potential carriers for urbanisation" (Ontwikkelagenda Toekomstbeeld OV, 2021); p.45).

Mobility hubs are seen as a solution to a variety of policy goals. Public transportation in the Ontwikkelagenda Toekomstbeeld OV (2021) is determined an essential link in this *chain mobility* as further investment in public transportation contributes to, firstly, healthy living environments due to the active transportation methods that are encouraged to be used in this chain. Secondly, it is mentioned that the ambition is to keep transit affordable and accessible to all, even in rural areas where the market for robust public transportation is diminishing. It is believed that the previously mentioned innovations can

counter this trend of transport poverty and tackle it, resulting in a system that embraces "carefree mobility" (Ontwikkelagenda Toekomstbeeld OV, 2021; p.12).

2.1.3. Node-Place-Experience Model

How well these different Hubs function as a network depends on multiple factors. The following chapter introduces how these factors assess the relevance of, and effectiveness of a Hub through a model; the Node-Place-Experience Model (hereafter NPE-model). This model has created a method to determine the values of different elements that together form Hub.

In order to assess the attractiveness of a station (or in this case a hub), models such as the Node-Place (NP) model by Bertollini (1999) are commonly used. The NP-model combines two different perspectives related to a stop in a network. On one hand, the hub has a function within the transit system, acting as a node where different modes of transportation meet one another and connect. On the other hand, the hub functions as a place that needs to be designed accordingly for passengers wanting to spend time there (Bertollini, 1999). However, Groenendijk et al. (2018) found the component of travelers' experiences while using these hubs to be lacking in the NP-model and believes that it is a critical component in understanding how well the hub functions. Groenendijk et al. (2018) applied the NPE-model on 32 transport nodes in the Rotterdam area. The criteria that were used to determine the value of each element in the NPE-model can be found in table …

Traveling with public transportation often consists of different elements within a single journey. How these elements are rated depends on the activity that is included within, as can be seen in figure 1. Peek and van Hagen (2002) created a schematic overview on the experience of an element of a journey, relative to the time spent doing it. This model has established clearly the importance of investments in Hubs and the significant gains possible. From the model it can be derived that transfers have the biggest negative impact on an entire journey. Therefore, the more time that is spent on a node, due to transfers taking quite some time for example, the more the overall journey experience worsens. Through improving the experience a passenger has on a hub through transferring, a qualitative impulse can be given to a journey.

NODE	Slow traffic	**Public Transport**	**Roads**
	Availability of bike rentals and bicycle parking; volume of local roads; presence of local roads.	**Volume of passengers using transit; frequency of bus/tram/metro services**	**Availability of parking spaces; freeway exits; number of regional roads**
PLACE	**Proximity**	Intensity	Mixture
	Intensity of land development in a radius of 300 and 1200m.	Maximum possible volume of people visiting separated in (1) residents, (2) employees and (3) visitors.	Degree of functions mixed in the area.
EXPERIENCE	**Comfort**	Ambien elements	Social elements
	Presence of heated waiting, sheltered waiting, television screens, free newspapers, WiFi, Supermarkets, stores, restaurants and toilets.	Type of architecture used and year of most recent renovation	Presence of personnel.

Table 1: (Groenendijk et al., 2018)

Three solutions were offered to enhance the experiences of these nodes: (1) by accelerating the transfer and thus reducing time spent on the hub; (2) by condensing the built environment, so less pre-transport is needed overall and (3) through enhancing the hub, making it more pleasurable for passengers to spend time. By transforming a Hub from a mere transfer spot to a destination on its own, it can be expected that these will receive greater scores on their position in the ranking compared to their position as shown in figure 1. NPE models are useful as they add a human perspective on a model equipped with a dominant, practical view. Elements of comfort and ease are important elements in a total scheme of customer needs that can positively contribute to the human perspective (Van Hagen et al., 2000). For example, the possibilities offered on a Hub for waiting passengers to do can alter their perception of waiting for their bus. The notion of "seamlessness" has been introduced in scientific literature to describe this sense of an effortless transfer within a journey (Hamiduddin et al., 2013). Effortless entails in this sense almost a compensation for the necessity to transfer. This compensation can be offered through different shops or other activities in which people feel not as if they "waste" time by being there (Hickman et al., 2015). This all confirms the psychological complexity and relevance of time spent on a transit Hub and how these perceptions can be changed with certain measures.

Investment in passenger experience has been happening under the Hub-project, adding facilities, improving the looks of Hubs and adding the brand. The OV-bureau Groningen Drenthe has data on both passengers' perception and knowledge on Hubs. The results of one survey quantitatively compares the passenger experience of a selection of Hubs from 2016 and 2019, the other on passenger's familiarity with and knowledge about Hub. The results of the first survey described showed an increase in passengers' perception of spending time on a Hub over the years (OV-bureau Groningen-Drenthe, 2020). The factsheet that lists the results described on hub Delfzijl can be found in Appendix D, to give an overview of the factors that were incorporated.

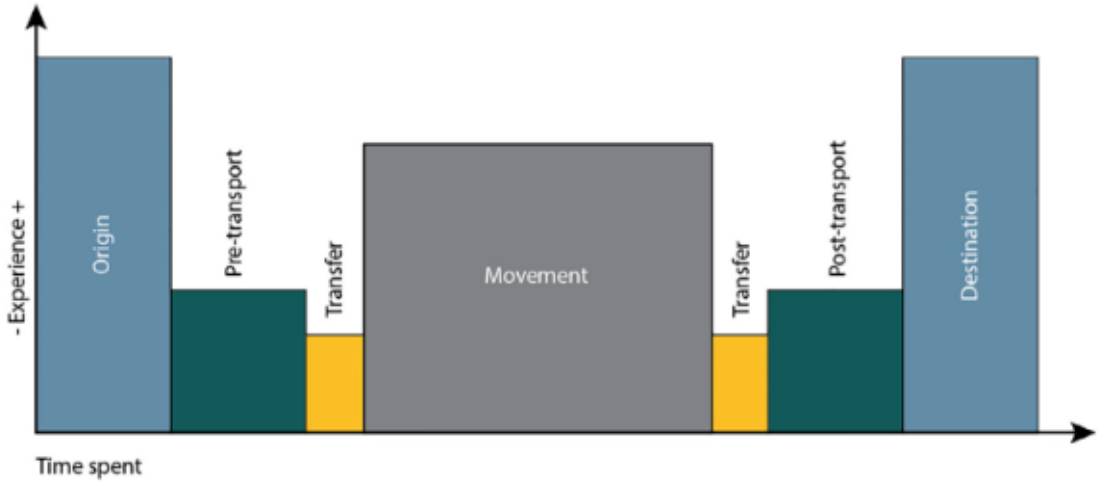

Figure 1 (Peek and van Hagen, 2002 – derived from Groenendijk et al., 2018)

2.2 Accessibility

The NPE-model interfaces substantially with the concept of accessibility, as the extent of how accessible a space in or around a hub can be or is perceived to be can largely impact the experience a user could have (Groenendijk et al., 2018). The following chapter sheds light on the multiple sides of accessibility and argues the importance of discussing accessibility's multiple facets within a hub context.

The definition of accessibility has been a topic of discussion among academics for decades. Pirie (1979) expresses the multitude of the concept 'hub' used in literature to explain other phenomena concerning human activity. Along this extensive usage of the concept, a certain insecurity emerged whether a full understanding of accessibility had been in place when using it to discuss matters. For example, Moseley (1979) defines accessibility as the degree to which "something" can be reached. Farrington & Farrington (2005) continued onto this notion by adding the concept of social inclusion in their definition: "the ability of people to reach and engage in opportunities and activities" (p.2). Other definitions were also

formed, which included a more practical, rationale approach to the concept rather than the human scale, stating it as “the general proximity in terms of time of all points in the region to a given kind of activity or facility” (Banerjee and Southworth, 1995; p.49). The concept inhabits multiple dimensions, which have been identified by Geurs and Ritsema van Eck (2001) as a (1) transportation dimension, (2) a land use dimension, (3) a temporal dimension and (4) an individual dimension.

2.2.1 Objective accessibility

Different sources of literature have overarching views on how to define accessibility. Another distinction made is between objective accessibility and perceived accessibility. Objective accessibility is concerned with using conventional methods to measure accessibility from one point to another through exact distance captures, and time-space and network measures (Lättman et al., 2018). Due to its relative ease in measuring, since there is a high variety in instruments available to measure with, has objective accessibility become the more investigated means of defining accessibility in projects and (inter-)national policy (Lättman et al., 2018; Shergold and Parkhurst, 2012). However, this approach to defining accessibility has been criticized due to it lacking the individual perspective on accessibility in assessing its conclusion (Curl, 2013; Shergold and Parkhurst, 2012). The objective approach on accessibility is known to assemble different amounts of information, which could potentially pose as an answer for mean population (Lättman et al., 2018). The trap in this approach thus can be that the individual scope could be forgotten or overlooked, resulting in a solution that does not resolve the issues for those who need it to be resolved for the most (Curl, 2013).

2.2.2 Perceived accessibility

Perceived accessibility is believed to fill in that gap of knowledge within the concept of accessibility. Perceived accessibility concerns itself with the personal perception on how to access destinations, or as Lättman et al., (2018) refers to it: "[perceived accessibility] consists of perceptions of the level of ease to access and use the built environment and transport system or access to activities of choice” (p3). What can be derived from this definition are both the levels of comfort those who use the transportation system (the passenger) experience and the freedom the passenger can exercise while making use of the system. The extent to which individuals perceive accessibility differently differs from per mode of transportation and per environment in which an individual desires to transport themselves. For example, Lättman et al. (2018) compared in a case study in Malmö (SE) the objective and perceived accessibilities for different districts based on different transportation modes (bikes, public transportation, car, walking). Coppola and Silvestri (2018) introduce and present a tool that supports in grasping perceived accessibility; the InViTo tool (*Interactive Visualisation Tool*). This tool visualizes the perceived accessibility of facilities

in an urban environment. These overviews are important to gain an understanding on the choices individuals make for their journey. From a study conducted by Dalton et al., (2015) it could be concluded that only 39% of the travelers chose the "objectively" shortest route for their commutes. 27% made trips further than the route the model predicted. These results reflect the personal component in decision making for journeys, addressing perceived accessibility becoming more and more relevant in research concerning travel patterns.

2.2.3 The misconception of the relationship between perceived and objective accessibility

Dalton et al. (2015) showed that the perceived measure in accessibility can differ from the objective, to be expected, accessibility results due subjective nature of humans. This mismatch is demonstrated in more literature across different domains, proving that a greater objective level of accessibility does not per se lead to a space being perceived as better accessible. For example, Koohsari et al. (2015) researched two groups with mirrored objective and perceived accessibility. The sample size included two sets of participants: participants of group A lived in an area objectively seen as highly walkable (high land-use mix, infrastructure up to standards) but considered it to be not walkable. Participants in group B on the other hand lived in areas that objectively scored below average on walkability, but they themselves perceived the walkability in their neighborhood to be much higher and thus gladly did so regularly. The results indicated that those in group A were less likely to walk through their neighborhood, even though objectively their opportunities were greater than those in group B. This proves that a proper, objective design of an area is not enough for individuals to eventually use the facilities offered. There is a role for the local government to actively promote the availability of amenities in the area to change the reputation (Koohsari et al., 2015). The municipality of Groningen recognizes this mismatch and tries to inform its citizens through, for example, an online platform where residents can find information about the different outdoor gyms throughout the city (Sport050, 2022). This makes it easier for inhabitants to perceive improvements in accessing spaces that, objectively, have been improved.

2.2.4 Urban vs rural accessibility in literature

When one reads through the literature in accessibility, it cannot go unnoticed that a large part of the literature on it is concerned with accessibility in an urban setting (Coppola and Silvestri, 2018; Lättman et al., 2018; Banerjee and Southworth, 1995). It creates interesting case studies, due to the variety in mobility options and the great number of individuals traveling through the same space. However, there remains an obvious demand for accessibility as well in rural areas, though these demands may differ drastically from individuals in an urban setting. Berg and Ihlströhm (2019) researched the mobility demand of rural Sweden's population. Their research concerned the accessibility, both perceived and objective, to activities and the motives for transport choice for rural Swedes. Findings were that using

the car for daily transportation had become the norm in these communities as the inhabitants perceived the public transportation that was provided to be inadequate to be dependent on firstly, since the services run too infrequently and take too long. Secondly, because the respondents perceived the roads and paths to access activities were too dangerous to be used by other transportation means than cars. This illustrates how literature in a rural setting is focused much more on the lack of available opportunities for inhabitants to access activities through different modes (Berg and Ihlströhm, 2019; Shergold and Parkhurst, 2012) where in an urban setting the focus can be found to more set to why an individual choses one mode over the other (Lättman et al., 2018, Coppola and Silvestri, 2018). In general, the perceived accessibility tends to become higher as the density of an area grows, plus the scores between objective accessibility and perceived accessibility differ the least (Lättman et al., 2018). That is due to the centralizing of functions in these areas, where these same functions and facilities are often further away in rural areas (Berg and Ihlströhm, 2019).

2.3 The relationship between transit Hubs and spatial development in an international context

It has been evident that there is a clear connection between investment in a transit Hub and increased spatial development around it, especially in international literature. However, this connection can be framed as a "chicken-or-egg" situation; from one perspective one can reason that an area with a lot of spatial development attracts the investment for better transit to accommodate the increased traffic. However, one could also argue that a new transit Hub attracts more businesses and people due to its accessibility and added capacity. A deeper investigation in this relationship is necessary to understand this situation.

Firstly, there is potential for the area serviced by the new transit Hub to densify, which also happens in certain cases. Basheer et al. (2020) explored the implementation of a BRT system in Lahore, Pakistan. Findings were that population densities around studied BRT hubs increased with over 11,5%. Public transportation moves people around more efficiently than private cars do in dense, urban spaces (Guzman et al., 2021). Secondly, new, improved transit services have a big probability of increasing land value in the direct catchment area of a transit hub. Saxe and Miller (2016) found through reviewing literature that land values can either drop 19% or rise by 120% (Bowes and Ihlanfeldt, 2001; Cervero and Duncan, 2002). The change in land value directly near the station was found to be influenced by choices made for transit accessibility. A station in Hong Kong, surrounded by park and ride garages, would receive 30% less of an increase in land value compared to a station area that had been designed according to Transit-Oriented-Development (TOD) standards, which includes high-density, walkable neighbourhoods with plenty of facilities in the near distance (Cervero and Murakami, 2009).

Both arguments are dependent on contexts that are specific for each case, and solidify the uncertainty whether the "egg" (read: transit) or the "chicken" (read: spatial development) came first. This discussion can be found throughout scientific articles, mainly within the context of what a new transit corridor does

(or would do) to a sub-region that is being connected with an established urban agglomeration. For example, Chen and Hall (2012) researched the potential impact two new high-speed corridors had on the sub-regional cores that were connected faster with other greater scale urban areas: one connection being London-Manchester and the other Paris-Lille. That article concluded that the to be expected positive consequences, such as a boost in the economy and labour market, did happen, but were limited to core of the sub-region itself and did not transcend into the hinterlands of these sub-regions. The conclusion seems to carry a notion that there is a lot of potential to be uncovered for development, but that is not yet noticed. However, the article does mention the factor of time playing a big role in these larger scale land transformations.

The potential for transit hubs to influence the change in urban, spatial development, was found to be influenced by the following factors: (1) existing land-use, (2) growth rate of population, (3) land regulations, (4) availability of land and (5) involvement of public sector (Basheer et al., 2020).

These factors also apply for the BRT hubs in Lahore; it's the second city of Pakistan, with an already existing urban fabric. Connecting existing residential and commercial areas through BRT was done in an effort to improve standards of mobility and accessibility that were lacking before (Basheer et al., 2020). The spatial analysis of Basheer et al. (2020) also highlight some densification around BRT hubs, but these are mostly smaller scale additions to the existing urban structure. The city had a population density of 4883 individuals per km^2 in 2010, three years before the launch of the first BRT route. That density grew up to 6279 people per km^2 in 2017, expanding their urban surface alongside (Nadeem et al., 2021). The BRT was a means to provide better accessibility and tackle congestion in an already dense, developing city, with limited funds.

As Cervero and Murakami (2009) already pointed out, the extent of TOD design determines greatly the land value. Hong Kong's case of expanding its already-existing extensive transit network, and therefore increase in TOD, comes forth out of a necessity to increase housing density as it is in the top 10 of cities worldwide with the highest population densities with around 7100 people per square kilometre in 2022 (ycharts.com, 2023). Hong Kong has a history of dealing with high population density due to limited land availability, having already a density of over 6000 inhabitants per km^2 by 1994 (ycharts.com, 2023). Investment in transit hubs in Hong Kong seems to be a means of expanding an already existing network and strategy of urban renewal.

This little comparison shows that the relationship between spatial development and transit investment in the shape of a Hub can differ a lot depending on the context. Whether it is the extent of development of a country, the size of the transit network, the urban form, etc. However, the most of the literature that discusses networks of Hubs consider systems set entirely in urban environments, including only the first the *Urban center* and *Suburban Hubs* determined by Bell (2019), overshadowing the relevance of the two remaining hubs (*regional* and *basic*) that are generally smaller of size and cover less dense

population densities. The examples discussed previously concern transit hubs of a totally different kind than the ones in Groningen and Drenthe through the scale they operate on, the population they serve and the services offered. The provinces of Groningen and Drenthe implemented transportation hubs on a more regional scale, which are spread throughout both provinces to mobilize all inhabitants and to ensure that each resident has access to public transportation within a certain radius. The municipality of Groningen determined the range of hubs that have been implemented into different categories than recognized by Bell (2019) , which will be discussed in the following chapter.

2.4 Relevant concepts linked to Hubs in policy plans

In the following chapter other concepts that were mentioned in the policy documents related to Hubs will be discussed and evaluated. Firstly, the link between *active transportation* and Hubs will be laid, followed by notions of *Forced Car Ownership*. This chapter will be concluded with an analysis of mentions on healthy city (or healthy aging).

Multiple themes, concepts and focus points were introduced in the policy documents that have been discussed in the previous chapter 3.3. These terms often share similar values and can be therefore grouped together in themes which have been reflected in scientific literature. This chapter will reflect upon the literature of the following concepts: (1) active mobility; (2) inclusive mobility and (3) smart mobility.

2.4.1 Active mobility

Active mobility, also known as active transportation, has mentions in all policy plans which were discussed in the previous chapter. The province of Drenthe refers to the concept as “sustainable mobility behaviour” (trl; duurzaam mobiliteitsgedrag) in chapter six of their policy document. The municipality of Groningen mentions in their policy plan to prioritize walking and cycling over all other aspects of mobility (Gemeente Groningen, 2021; p.7). The municipality of Groningen stresses the importance of active mobility through lessons learned during the COVID pandemic, and explores how exercise can be combined with recreational opportunities. The province of Groningen dedicated chapter 4.2 of their policy plan on active mobility, stating that “cycling and public transportation is a golden combination” (Provincie Groningen, p.66).

Active transportation (also known as active mobility) is a phrase intended to encompass all journeys made that are human-powered; that include the person perform physical activity to go from point a to b (Glazener and Khreis, 2019). Traveling via public transportation has been proven to support an active lifestyle as people on average move more and are encouraged to use more active transportation methods, such as walking or cycling (Glazener and Khreis, 2019). The actual active part of transportation in a NPE-model context will be during either the pre- or post-transport parts of an individual traveling via a

Hub (see figure…). Notions such as forced car ownership (FCO) are frequently named as the problem that active transportation through policy is trying to solve (see next chapter). Research on "active transportation through public transportation" is also often linked to urban concepts such as *The Healthy City*, which stress the importance of livable city design to mitigate air pollution or lack of physical exercise (Glazener and Khreis, 2019). When one refers to the setting of the Hub-project, they cannot solely speak of an urban environment, as the network of Hubs is intended to bridge easier connections among both urban and rural areas. Nevertheless, the notion of active transportation remains relevant in a rural context, where car dependency is far more prevalent as it is often the only mode of transportation people feel they can depend on (Stradling, 2007; Lättman et al, 2018; Carrol et al, 2021), resulting in FCO (Carrol et al, 2021).

The physical implementation of active transportation policy in spatial design can be done in multiple ways, depending on the context of the environment in which the spatial lay-out will be adjusted. Different factors can be therefore included in deliberating what the necessary steps are to make to improve from the current situation. In general, it accounts for three factors to determine the attractiveness of a trail: aesthetics, convenience and accessibility (Sallis and Owen, 2002). García and Khan (2018) discuss the notion of safety together with active transportation. Their empirical research was based on the relationship between the perception of safety along trails that form a network for pedestrians and cyclists to move around in Salt Lake City, Utah. Multiple agents were recognised, in the interviews conducted, that were said to influence a user's perception of safety when traveling along these trails, such a the presence of motels or liquor stores (García and Kahn, 2018).

2.4.2 Inclusive mobility

The municipality of Groningen states that a holistic approach to mobility should be included to create proper policy for all, which therefore includes many, different aspects of mobility. The municipality of Groningen believes that encouraging people to walk as a means of transportation does not only solve mobility policy, but also other ambitions set out, such as the strive for a healthier and more inclusive society, and an overall increase in socioeconomic welfare (Gemeente Groningen, p. 50). The province of Drenthe does not explicitly mention that inclusivity was (or is) a core value during the assembly and implementation of the policy plan. The province of Groningen, in contrast, has chosen to highlight inclusive mobility through assigning it to be one of their eight societal challenges for the foreseeable future (Provincie Groningen, 2022; p. 25).

This "right to mobility" has grown in relevance over the past years. Despite the legal recognition it has received in the USA in the midst of the 19th century (l, 2006), there is an obvious lack of transportation opportunities for those who are financially or physically bound to restrictions, especially for the population living in rural areas (Ranchordás, 2020). Ofcourse, one has the freedom to go as they please,

as long as they have got the means to transport themselves. And even if rural inhabitants possess a car, chances are that they are not financially viable to own one, resulting in Forced Car Ownership (FCO).

FCO is a term that entails the lack of transportation opportunities for lower-income households, which therefore depend on getting around by their car, which they essentially are not economically fit for (Carrol et al., 2021). This results in "*the households cutting expenditures on other necessities and/or reducing traveling to a minimum*" (Mattioli, 2017). This in turn may lead to social exclusion (Mattioli, 2017; Carrol et al., 2021), with those who are unable to use a car at an even higher risk, such as the elderly, children or those with disabilities (Hancock et al., 2017). Therefore, battling FCO and encouraging people to make more use of other modalities, explicitly including public transportation, is a fitting strategy (Ontwikkelagenda Toekomstbeeld OV; Mobiliteitsvisie Groningen Goed op Weg) for policy makers and governmental institutions in their battle for more social equity. Hunter et al. (2021) states that battling FCO meets standards set by the Sustainable Development Goals by the United Nations (3. Good health and wellbeing; 9. Industries, innovation, and infrastructure; 10. Reduced inequalities; 11. Sustainable communities and cities; 13. Climate change; and 15. Life on land), making the Hub project an initiative that fits into the narrative of international sustainability policy.

Transit poverty is associated with FCO, in the sense that both concepts are concerned with the unaffordability of an individual or community to get around and all the consequences that arise as a result of it (Ranchordás, 2023). An indicator was calculated by the Dutch Central Bureau for Statistics to assess the risk of an individual or community to being exposed to transit poverty. Those variables include income, distance to public transportation, vehicle ownership, the presence of either physical or mental disabilities, age, and distance to public services (CBS, 2019; Ranchordás, 2023). This data provided an overview of areas in the Netherlands where transportation options are more limited, compared to areas where these are more available. Nonetheless, the Netherlands lacks a constitutional recognition of the necessity for accessibility, though there has been some recognitions by government officials that accessibility and mobility should be a right for all. The minister of infrastructure and water management (Harbers) stated that "*accessibility is a right for all Dutch people. Whether you live in a city or far outside of one, you need to be able to access everywhere in the Netherlands*" (Rijksoverheid, 2023). The secretary of state for the same ministry (Heijnen) acknowledges that "*the social function of mobility needs more attention and ambition … Accessibility should be a basic right just as education is*" (Rijksoverheid, 2023).

Daubitz (2023) argues that it is social innovations which determine the extent of success for inclusive mobility policy. Self-empowerment is mentioned as a desired result of such innovations, as those who are systemically neglected in their mobility desires often lack the knowledge or capacity to mobilize themselves (Daubitz, 2023). These bottom-up approaches are not guaranteed success for the inclusive

mobility policy to work, but remain a crucial element in the goal to eventually make mobility entirely inclusive (Daubitz, 2023).

2.4.3 Smart mobility

The usage of the word smart in combination with mobility can be quite ambiguous and broad. In general the word smart accounts for creating more efficient mobility (Provincie Groningen, 2023). Throughout their policy plan, the municipality of Groningen sticks to a comparable narrative of smart, in which a strategy, innovations and network-thinking are considered crucial elements for the system to become more resilient for the future. The Province of Drenthe states in their policy plan comparable notions of smart, with the explicit wish of reducing the amount of kilometres driven by cargo and personal transportation (p.8). The province of Groningen dedicates one of the main themes in their policy plan on smart mobility and combined it with green mobility, arguing that the two go hand in hand.

Ranchordás (2023) mentions a slightly different meaning to Smart Mobility, really cornering the IT characteristics of the solutions that are offered to mobility problems. Ranchordás (2023) recognizes four technological elements of smart mobility in literature: (1) vehicle technology, (2) Intelligent Transport Systems, (3) data, and (4) the development of new mobility services. An example of such an innovation is Maas; Mobility as a Service. Maas is a concept that has seen a development of what it exactly entails (Jittrapirom, 2017). Its first definitions included an interface of a single system which provides the exact needs and desires for an individual's journey, integrated through new innovations made possible because of the internet (Hietanen, 2014; Cox, 2015). Jittrapirom (2017) explains that different providers will be consulted to fulfil for different parts of a journey. For the ease of customers a payment system is at the base of the concept which creates a simplified overview of all transactions for each provider, under one bill. This should make it more attractive for people to use different modalities when travelling and should support the usage of sustainable transport methods (Jittapirom, 2017). As it seems, the Hub concept complements the Maas concept in the physical domain, offering attractive spaces where people easily forget the "effort" it takes to switch modalities (van Hagen et al., 2000).

The downsides of the digitalization of public transportation should not be ignored. There seems to be a focus in scientific literature on the social implications of introducing Maas as a standard means to use transit services. Pangbournet, et al. (2020) argues the threat of market mechanisms for public transportation that is considered a public service. The private market, which Maas relies on for providing mobility services, competes to become the most successful provider of a service in the network (Jittapirom, 2017). These companies have the tendency to prefer profit over anything, neglecting the social responsibility of an accessible public transportation network (Pangbournet, et al., 2020). On top of this, the digitalized nature of Maas requires certain skills of how online services work, which should not be assumed for a part of the population. There is an elderly population that struggles with these online systems and there is other people that simply do not want to engage with digital services for any

reason possible, albeit that privacy is the most common argument (Pangbournet, et al., 2020; Cottril, 2020).

2.5 Conceptual model

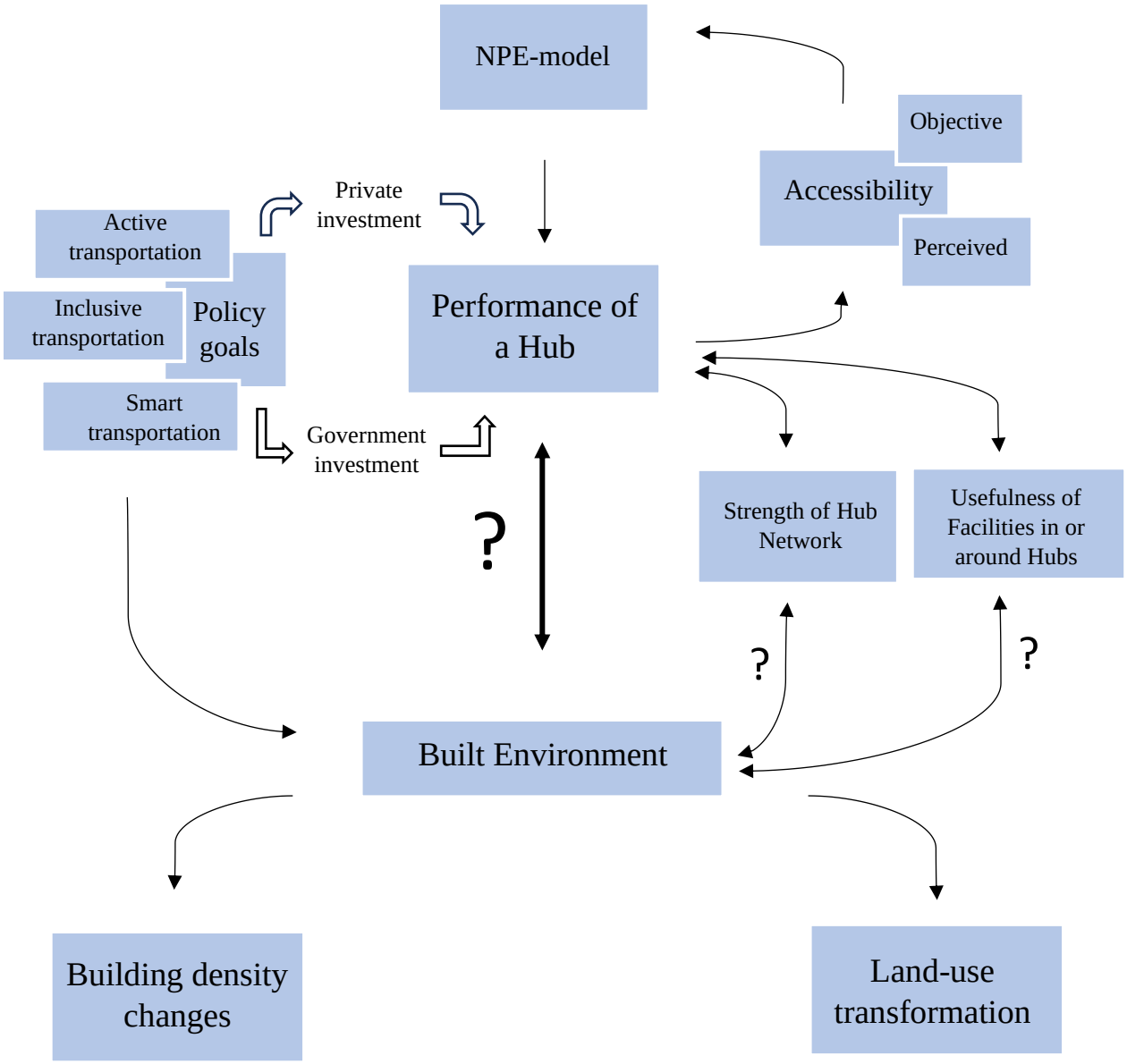

Figure 2: The conceptual model

At the core of this thesis lays the research question: What is the relationship between Hub investments and the spatial development within a Hub's area of influence? That question is represented in figure 2 with the question mark in the middle. Figures have shown that investment in the quality of a Hub aligns with the overall performance of a Hub and to what extent people enjoy travelling via one. This investment is largely funded by government subsidies to fulfil policy goals that these institutions have set out in their mobility policy plans discussed in chapter 2.1.2 and 3.4. However, it is not solely based on government funding, as there is also providers of mobility services active that take part in the private

market, as discussed with Maas as example in chapter 3.4.3. The overall performance (or quality) of a Hub determines the extent of both perceived and objective accessibility of the actual Hub firstly, but secondly also its area of influence. This wide notion of accessibility is an important element for all three factors in the NPE-model. The NPE-model itself is a determinant of the performance of a Hub, as discussed in chapter 2.1.3. This circularity in the model represents the constant assessment required of a Hub's performance. The "strength of the network" and "usefulness of facilities in or around Hubs" function as subordinate factors to the "performance of a Hub" in this research, as discussed in chapter 2.2. They are displayed in this conceptual model to include the different layers of scale a Hub performs within. Furthermore, the policy goals discussed in chapter 3.3, and associated concepts in chapter 3.4, also include certain notions of direct involvement in the built environment, hence the direct connection in the model. These efforts for spatial development are the physical results of policy implementation either directly on the built environment or via investments made in Hub. For this thesis, the focus on changes in spatial development have been separated into two different categories: (1) the degree of changes in building density and (2) the number of land transformations noted within a certain period of time. These factors for the extent of land transformations have been derived from literature discussed in chapter 2.3.

Figure 3 showcases the same conceptual model as displayed in figure 2, but parts of the model have been categorized for an easier display of how the different parts are interconnected. The process of implementing a Hub comes from the idea of enhancing the living environment (red), as discussed in the introduction. To know whether an intervention works, assessments need to be carried out to determine the change in quality of a situation (green). There are substantive factors to this measure of performance that are encased in yellow. In the end, the extent of effect between a hub performance and built environment depends on the extent of changes in factors that account for changes in the built environment. These are encased in an orange circle.

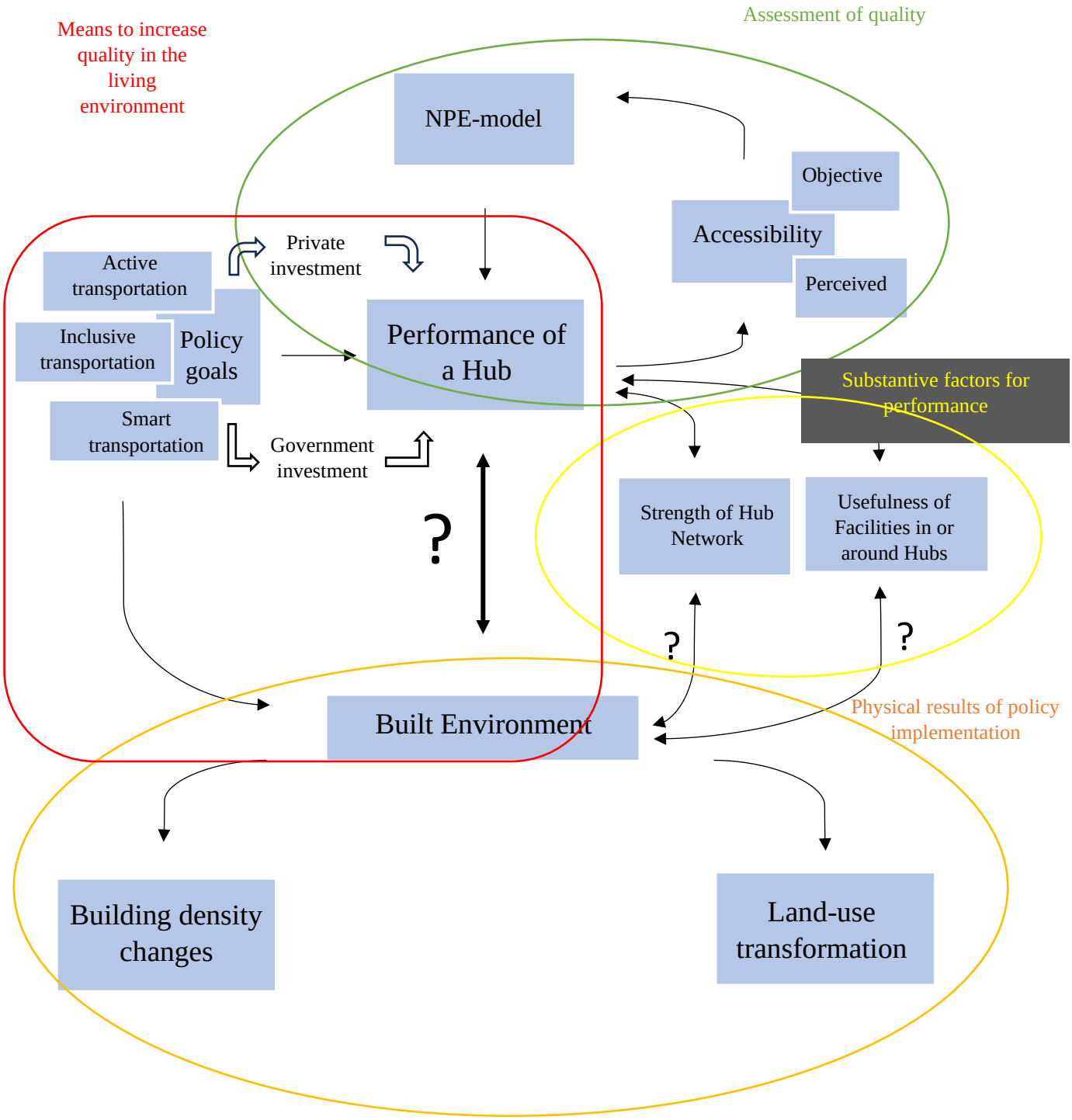

Figure 3 – Conceptual model divided into sections

3. THE HUB PROGRAM IN GRONINGEN AND DRENTHE

The infrastructure currently present reflects the policies discussed in previous chapters. To express its significance; the hub concept in Groningen and Drenthe receives praise in the *Ontwikkelagenda* as it showcases how a network interacts properly through different nodes on a regional scale. Both the interplay of different bus lines, and the investment in spatial location and infrastructure were noted to be significant to its success.

3.1 The network

Spread across both provinces of Groningen and Drenthe a network has been established of 55 Hubs, which cover all inhabitants within a range of fifteen kilometres (Handboek voor Hubs, 2019) These Hubs have been classified according to their (in-)direct range of services and significance in the network. This classification aligns for a great part with both determinations previously discussed in chapter two. However, the Hubs are classified along standards set up by the provinces of Groningen and Drenthe. These different types of Hubs will be discussed later on in this chapter.

The network of Hubs is served by a bus system that characterizes itself through a strict hierarchy of different types of bus services that run through the region (OV-bureau, 2022). These different services are sub divided into the following formula:

Qliner	**These buses run between bigger nodes and link multiple HUBS together. Little intermediate stops are made, which give these buses high average speeds. The routes these services take consist of mainly highways. Therefore the buses used on these routes can reach a maximum speed 100km/h instead of the usual 80km/h for standard buses.**	**Foto QLiner**
Qlink	As of 2023, eight services are bundled into four, color-coded corridors that connect important nodes in and around Groningen with one another. These services are run with higher capacity, metro style buses that partially run over dedicated busways. Big contributors to its ridership numbers are the proximities of Park and ride facilities on the routes, bundling different sources of passengers onto the same service.	Foto Qlink
Regular buses	These bus services are more traditional in nature and link villages with one another. These buses stop more often, have lower frequencies and are also prone to	Foto stad/streek

	lower average speeds. A cosmetic distinction is made between regular buses in the city or those across the region.	
Ancillary buses	Ancillary routes mainly carry a social function and run services where there's a societal need but the route not per se being profitable. These routes intend to link rural populations to health care services, supermarkets, libraries, etc. Included under this formula is also the HUBtaxi; a taxi services that picks passengers up from their doorstep and brings them to the nearest HUB, where this passenger can transfer further on a QLiner/Qlink/Regular bus service.	Foto HUBtaxi/buurtbusje

Table 2 - Overview different types of bus services possible on a HUB (OV-bureau GD, 2022)

These different services often meet at nodes in the network, in this case Hubs. These Hubs are located in strategic locations. These can be either in the middle of rural cores, with the argument to serve the most people within that core and have great visibility, or they can be located in places that are beneficial for the service of the buses. In the case of Q-liner buses, it can be disruptive for the average speed of the service if the bus has to go through dense and tiny villages. A regular or ancillary bus is more suited to cover such areas in this hierarchical system. Hubs are then the places where these services interact with each other and provide interesting and quick travel options to the most popular destinations. The idea of Hub is then that these transfers are as comfortable as possible. However, to make these transfers as attractive as possible, the Hubs need to be attractively designed spaces on their own (Peek and van Hagen, 2002).

3.2 The facilities

Prior to the launch of the HUB concept, a leading assumption was that the nodes in the network needed to become attractive spaces with a certain standard of quality, where people would enjoy spending time (Handboek voor Hubs, 2019). Dependening on the type of Hub certain facilities can be expected to be present. Nevertheless, the Handboek voor Hubs (2019) states that the customization of each Hub is different from one another, and that therefore a different selection of facilities can be found. This gives the opportunity for a Hub to reflect more explicitly their local connection with its environment and cooperate with already exisiting services nearby; the library in Roden for example (see introduction). Handboek voor Hubs (2019) states three categories of facilities, reflecting their priority of implementation; Basis, Ambition and Optional, summarized in figure … . The first category includes elements that can be found at the foundation of a Hub. "Ambition" includes prioritized, extra facilities

that significantly contribute to an experience on a Hub. The latter also add onto the experience, but have less of a priority when it comes to necessity.

Basis (Hiernaast plaatje Hub netwerk) • **WiFi** • **Watertap** • **Real time digital bus display**
Ambition • **Wayfinding** • **Bicycle lockers** • **Bicycle pump** • **Seating element** • **Charging point for cars** • **Toilet**
Optional • **Fitness equipment**

Table 3 – Overview of initial priorities of facilities on Hubs.

3.3 Mentions of Hub in national and regional policy documents

The idea of Hubs has been discussed in multiple policy documents, often referred to as the future of transportation. The narrative in which Hubs are discussed in these policy documents tends to parallel with the statements made in the Ontwikkelagenda Toekomstbeeld OV (2021): Hubs are spaces where different transport modes interconnect along existing infrastructure corridors (Ministerie van Infrastructuur en Waterstaat, 2022; Witte and Kansen, 2020**;**. The specific concept of Hub that is being discussed in this paper (Hubs in Groningen and Drenthe) has been addressed prominently in the Ontwikkelagenda Toekomstbeeld OV (2021) (p.68-69) as an example of how one travels via Hub. The concept also has mentions in three regional policy documents that are concerned with the mobility of inhabitants in Groningen and Drenthe: (1) The *mobiliteitsvisie Groningen Goed op weg*, published by the municipality of Groningen; (2) *Mobiliteitsplan Drenthe;* written by the province of Drenthe, in cooperation with its 12 municipalities; and (3) *Wat Groningers beweegt*, a policy document set up by the province of Groningen.

3.3.1 Mobiliteitsvisie Groningen Goed op Weg

The municipality of Groningen set up the *Mobiliteitsvisie* to prepare institutions for the changes in mobility to come, such as reducing the role of the car even further within the city and thus making more

space available for pedestrians and cyclists . Main topics of discussion are on network improvements for either public transportation or bike routes, and redesigning streets to enforce lower traffic volumes and speeds. All of this to accommodate a growing number of inhabitants in Groningen. Hubs are addressed rather shortly in this document, as a solution towards the conventional problem that when one makes a trip, that it is likely to be made with a single mode of transportation. Chain mobility, as introduced by the Ontwikkelagenda Toekomstbeeld OV (2021) entails the switching between different modes of transport within a single trip. Hubs play an important role in facilitating the different transport modes in a comprehensible manner, where in a blink of an eye people get to see the different choices they can make to travel. Three different hubs are determined within the municipality:

- Trainstation Hubs
- Park and Ride Hubs
- neighborhood/village Hubs

If one compares the descriptions of these hubs with those identified by Bell (2019) , similarities can be spotted in their characteristics. Also, it makes sense that the regional hubs identified by Bell (2019) are not relevant for the municipality, as the municipality is solely responsible for the development of Hubs within their jurisdiction.

3.3.2 Mobiliteitsplan Drenthe

There are a lot of similarities between both mobility plans of Groningen and Drenthe, which can seem obvious due to their multiple joined efforts when it comes to mobility and development (OV-bureau Groningen Drenthe, RGA). The main difference can be found in the inclusion of services around Hubs. The mobility plan of Drenthe amplifies their desire to centre crucial services on these Hubs, to reduce the necessity for rural communities to travel for these services. This distinction makes sense when one considers the more rural nature of Drenthe.

3.3.3 Wat Groningers beweegt, Programma mobiliteit

The mention of Hubs in this policy document builds further upon the concept of carefree mobility, first seen in the Ontwikkelagenda Toekomstbeeld OV (2021). Carefree mobility is seen as a goal, that is split up in multiple themes to be discussed holistically. The mobility hubs are mentioned in relation to three of the six themes determined: firstly (1) public mobility. The province states that it desires to create one network of mobility that everyone should be able to use and that the investments made in the Hub concept make public transportation more accessible to everyone. Hubs are used as a backbone for a standard network of public transportation in Groningen and Drenthe. Secondly, (2) active mobility discusses Hub as a means to encourage people to make use of active transportation methods as links in their journey, circumfixing back to the notion of chain mobility. Investing in bike parking on Hubs and bike and pedestrian access to Hubs could make it more attractive for people to participate in active

transportation methods. Thirdly, (3) smart and green mobility, as a theme, briefly mention Hubs in relation to autonomous vehicles, proposing the possibility of these vehicles covering the last-mile of someone's journey, with a Hub as either a starting or end point.

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4. METHODS

This research has the goal to understand the relationship between a transit stop becoming a hub and the spatial development that happened in its surroundings on different scales. This research relies on the main principles of an effect evaluation as it is an attempt to understand the effect a Hub has on spatial development. Multiple types of both primary and secondary data have been gathered and analysed to assess this understanding objectively and correctly.. These types of data provide information on changes that happened between the two years chosen to compare; 2016 and 2023. These changes can occur on three different levels of scale: micro, meso or macro levels. A schematic overview of the research methodology can be found in figure …. The data has been collected for five different Hubs within the Hub-network, spread across Groningen and Drenthe. These five Hubs will form five separate case studies, which will be discussed in the Results section.

4.1 The fundamentals of an effect evaluation

Effect evaluations consist of processes through which the impacts (hence also known as impact evaluations) of certain interventions are assessed. These interventions can be applications of policy or the introduction of certain programs (de Jong et al., 2020). The Hub concept is a result of a public policy measure by the government to invest in mobility. Therefore, this effect evaluation is just as much a policy evaluation. In this case study, the implementation of Hubs is the intervention taking place on a transit node. Therefore it is important to create a comparison of a Hub during two different periods in time, to evaluate what has changed and whether that is linked to spatial development in its area of influence or not.

An evaluation ladder has been constructed by Mensink (2015) to provide an overview of the different policy evaluations available. This ladder (see figure 4) rangers from an extremely systematic approach with a high degree of certainty to an approach that is led primarily by intuition, resulting in a low degree of certainty (Mensink, 2015). Appendix C provides an overview of the criteria that suit each type of evaluation mentioned in figure 4 . The description of *effect research* corresponds with the research design of this thesis:

“Disadvantages of both the situation research and the goal-achievement research is the uncertainty about the contribution of the instrument to the observed change. In effect research this is encountered by adapting the “with-without” approach (comparing the situation ‘with’ the use of the instrument and the sitation ‘without’ the use of the instrument)” (Mensink, 2015: based on van de Graaf en Hoppe, 1996).

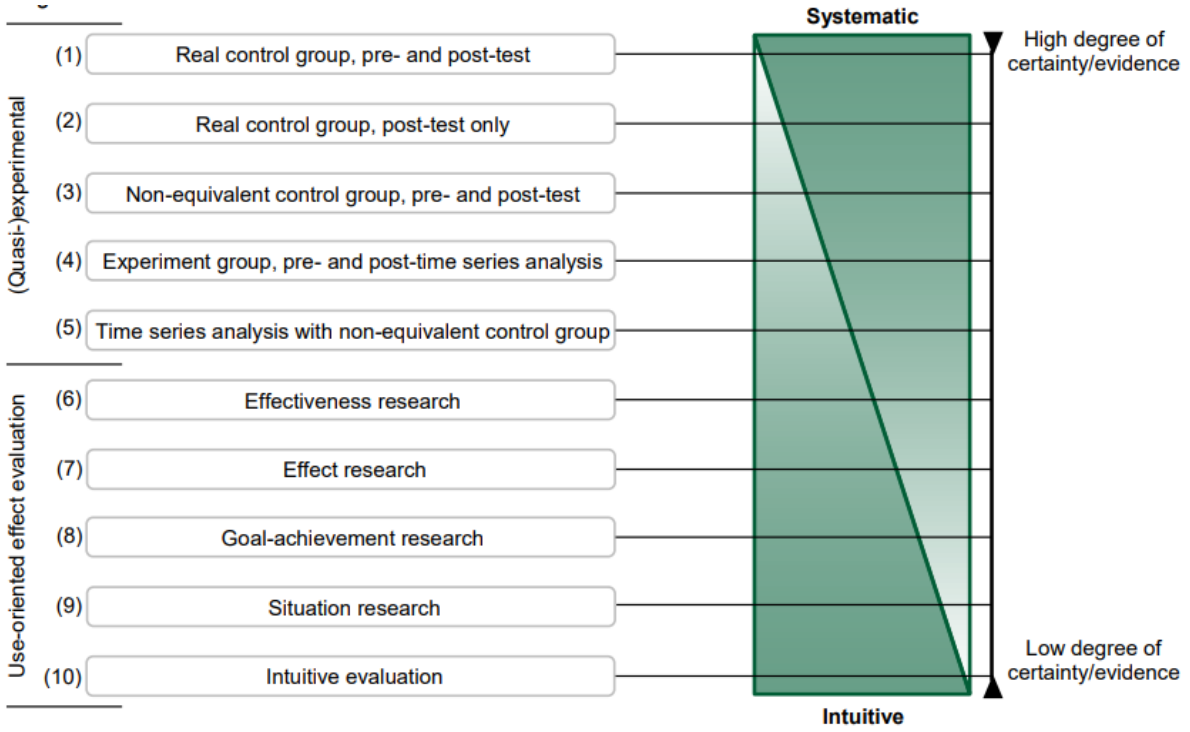

Figure 4 - Evaluation ladder based on degree of certainty (Mensink, 2015).

Principles of user-oriented effect evaluations are radically different from most academic evaluation exercises. Academic evaluations solely look for a cause and effect relationship within an isolated environment and ignore all context (King, 2007). User-oriented effect evaluations are done differently, focusing on whether a selected group of people, who "use" a system, are really benefitted by this system. Factors that determine the extent to which these users benefit from such a system would then be "whether the system will help them to do so effectively, productively, safely and with a sense of satisfaction" (King, 2007 p.128). These are all subjective factors by nature, which results in a complex determination of what interventions have actually been a good choice.

Questions to be asked to assess the effect should be either descriptive, causal or evaluative by nature. Examples of these types of questions can be found in handbooks written by the OECD. It has to be noted that these questions have been developed by the OECD to evaluate the effectiveness of policy implementations in developing countries and therefore automatically exclude the location of the case study: the Netherlands. However, these questions are written with an objective, neutral tone that allows for an evaluation nonetheless in any situation.

4.2 Primary data collection

Concerning the primary data that has been collected, in-depth interviews have been conducted with individuals either using the Hubs or those who live or work in close proximity of the Hub, an overview of these questions can be found in appendix E. A total of five qualitative interviews were held, one for each Hub that has been chosen to be included in the case study. The questions asked in these interviews

were open-ended by nature and gave the participants the opportunity to share their personal experiences with traveling via a Hub in Groningen and Drenthe. Their answers provide useful data for understanding the perceived accessibility of Hubs. Other primary data was collected during fieldwork visits to each of the five Hubs. A visual observation of the Hub and its direct surroundings provide an overview on what facilities are offered on each Hub in 2022, which has been selected for the case study. This data will be compared with secondary data that describes the state of facilities offered for these hubs in 2016, creating a necessary comparison. All primary data collection has focused on collecting micro scale data, since the data is more accessible to be obtained within the scope of this research. However, data from a micro scale is not sufficient on its own as it lacks the information of the Hub's functions on a systemic level. The micro scale data only says discusses the Hub itself, not its surroundings and not its place in the network. Therefore, also the meso and macro scales are included, which will be discussed later on.

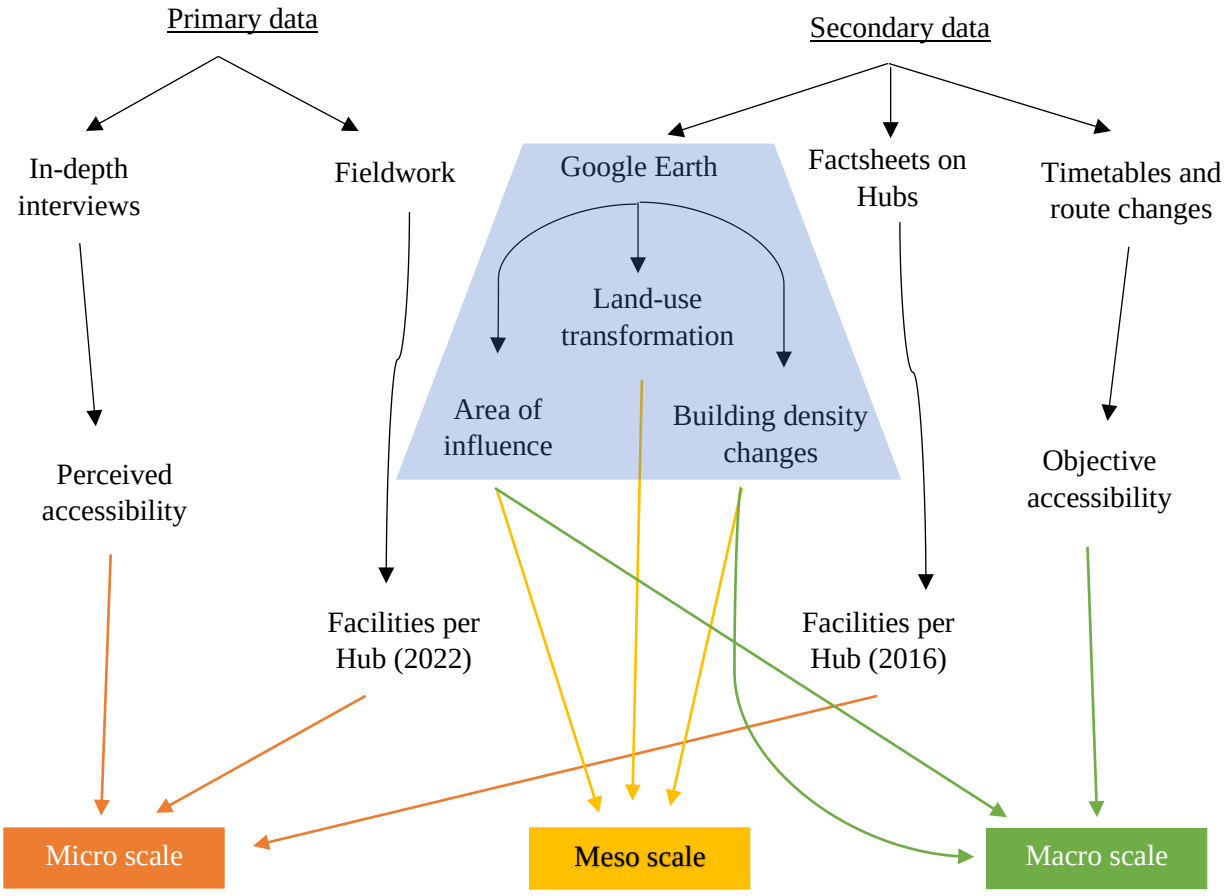

Figure 5 Overview of types of collected data and their relevant levels of scale.

4.3 Secondary data collection

The secondary data existed out of three elements of data: (1) satellite images provided by Google Earth, (2) factsheets on Hub performance and (3) timetable and route changes for buses and trains. The satellite

images provide data to perform a map analysis of the immediate area of the Hubs and also their area of influence. Satellite images from two different years (2016 and 2022) were consulted so an overview could be provided on changes in land-use. Basheer et al. (2020) included the following factors into this map analysis: *Land-use transformations* and *changes in buildings density*. In this research we adopt these factors and add the factor *Area of influence* to reflect the regional characters of the Hubs in the case studies. Furthermore, factsheets on Hub were accessed through the OV-bureau Groningen-Drenthe and provide crucial information on the facilities each of the selected Hubs offered in 2016. The selection of case studies is also based on this factsheet as the extent of Hubs that was discussed in this factsheet spans over five Hubs. The final element of data consists out of timetable and route changes of the public transport modalities that serve the Hub. The different modalities that are included in this section are buses, trains and ancillary buses. Understanding the changes in public transport services stopping at Hubs sheds not only light on the changes in the objective accessibility of Hub, but also interconnectivity of the public transportation network and therefore the relevance of a Hub within that same network or its area of influence.

4.4 Different levels of scale

The decision has been made to analyse the adjustments made as a result of the Hub concept according to different levels of scale. The Hub concept in Groningen and Drenthe has a regional character, where the role of each Hub expands beyond its direct environment. These different levels of scale have been categorized as micro, meso and macro levels. This approach has been adopted across multiple, different fields, such as economic geography or business. However, the reason for such an analysis remains the same for each field: to conduct a holistic analysis through different perspectives.

4.4.1 Micro level

For the micro scale, the range of changes will be considered is within the direct environment around the Hub. The actual surface that will be analysed depends on what areas actually constitute the Hub. Analysing from this perspective gives us clarity in changes among the amenities and facilities offered within the direct surroundings of places where passengers spend a lot of time and want to have comfort. This point of view also corresponds with the experience value of the NPE-model.

4.4.2 Meso level

To grasp the relationship of a Hub and spatial development on meso scale, a radius of 500 meters will be drawn around the centre of the Hub. This distance equates to a walking distance of around ten minutes. Basheer et al. (2020) u Considering the type of development been built between 2016 and 2022 will help us understand influence of Hub investment on its direct surroundings. By considering the possible changes in road infrastructure and accessibility around the Hubs some light will be shed on the

degree of objective accessibility. The reason for doing this is to understand the matter of interconnectedness between the Hub and its direct surroundings.

4.4.3 Macro level

This point of view includes the wider region that the Hub serves. It is important to include these in the analysis, since certain Hubs function as a transit node for a service area greater than its direct surrounding. It has since been determined that we refer to this area as *area of influence*. This area of influence on a macro scale will be drawn per Hub by looking at the following two criteria:

(1) *a village or town that has no day-covering [1]public transit service from Monday to Sunday and therefore relies on the Hubtaxi or bicycle (either a portion of the week or the entire week) to reach this specific Hub, since it is the nearest Hub, to make use of public transportation*.

(2) *The distance to a bus stop with a day-covering service exceeds the distance of two kilometers.*

This excludes therefore rural cores that are covered by either HOV or basic lines, but still lack a Hub. These villages or towns might still enjoy facilities offered by this Hub, but are not dependent on it for travel. The boundary of two kilometres is based on the notion by the *CROW* that most people are willing to walk five to ten minutes to a transit stop. If that same time standard can be applied to how long people are willing to bike to a transit stop, the distance becomes two kilometres. The distance displayed in the following macroscopic maps *Comparing* the degree of transit connectivity from Hub A with village B, Town C, etc., across a timespan will provide an understanding of how the area of influence has changed of Hub A. This will provide insights to whether the extent of accessibility to a Hub affects the matter of spatial development beyond its direct surroundings. Researching this matter of interconnectedness within a transit system relates to the Node factor in the NPE-model.

In short, the research design includes three different levels of scale, for which each creates a comparison between 2016 and 2022 for their respective values. It is believed that by interlining the outcomes of the three comparisons that an understanding can be established on to which extent these are interrelated and whether there are correlations. The data sets that are exempt from the comparison are the in-depth interviews, simply because there have been no records of such interviews from 2016. Also the Hub area of influence has not been compared, due to the concept of Hub not being introduced yet in 2016 and therefore also no Hubtaxi service was offered, which was an indicator for the 2022 map. An overview is provided in table 3.

[1] Weekdays between 06:00-00:00, weekend 07/08:00-00:00

Data	**Years**	**Values**	**Sources**
In-depth interviews	2022	-	Fieldwork
Facilities Hub	2016 & 2022	-	Factsheet & fieldwork
Transit timetable & routes	2016 & 2022	Frequency, type of bus service, train service	Policy documents & online fora
Hub area of influence	2022	Rural cores, distance to day-covering bus service >2km.	Transit timetables & Google Earth
Building density changes	2016 & 2022	Change of plot designation	Google Earth
Land-use transformation	2016 & 2022	Residential, industrial, commercial, empty	Google Earth

Table 3: Overview of research design and necessary sources.

4.5 Case studies

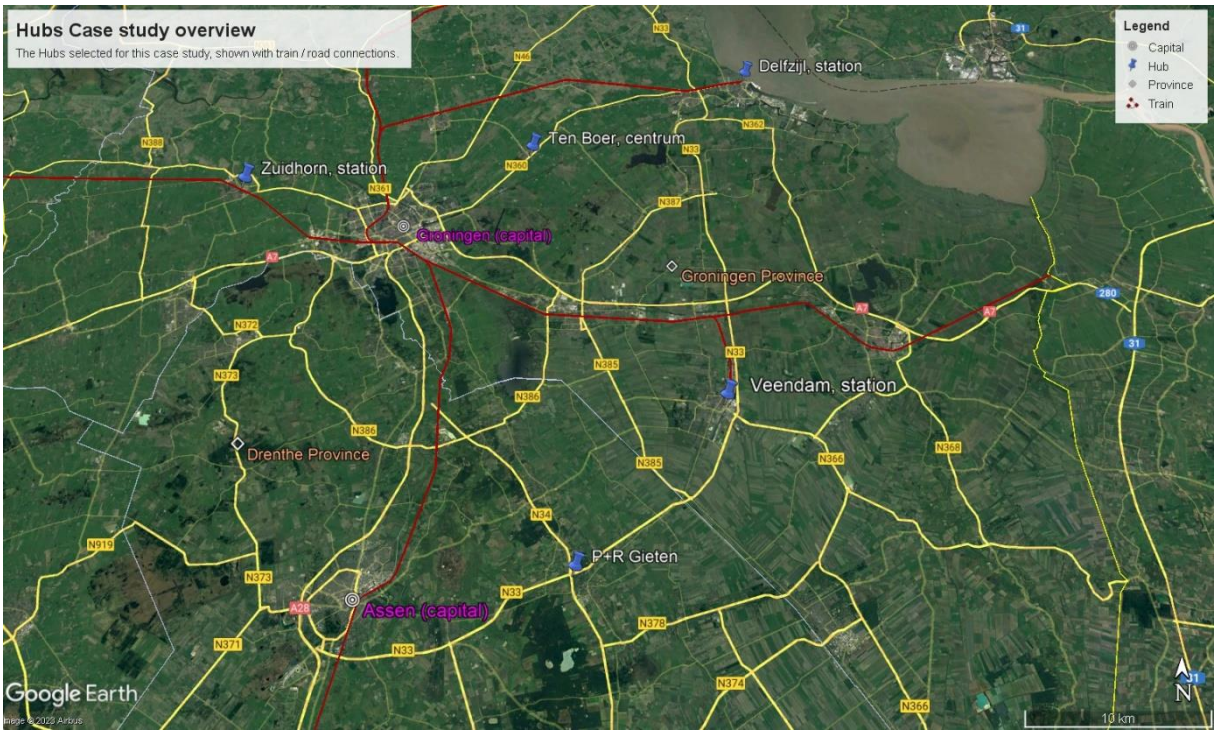

Figure 6 – overview of geographical locations of case studies

As mentioned before, five hubs have been selected to act as case studies for these effect evaluations. The hubs selected are (1) *Delfzijl, station; (2) P+R Gieten; (3) Ten Boer, centrum; (4) Veendam, station* and (5) *Zuidhorn, station*. These Hubs were selected because of the available 'historical' data of the facilities that were offered in 2016 on the factsheets provided by the OV-bureau Groningen-Drenthe.

4.5.1 Delfzijl, station

Hub Delfzijl, station is located on the railroad Groningen-Delfzijl and hence also the terminus of passenger services on that railway. The Hub is situated towards the north of the city centre, with the river Ems further west and more residential development towards the north and east. According to the different types of Hubs defined by the policy document *Mobiliteitsvisie Groningen goed op weg* this transit node could be classified as a *trainstation Hub*.

4.5.2 P+R Gieten

Hub P+R Gieten can be found towards the north west of the village Gieten. Its is sandwiched in between the edge of the village and the junction of regional roads N33 and N34. According to the different types of Hubs defined by the policy document *Mobiliteitsvisie Groningen goed op weg* this transit node could be classified as a *Park and Ride Hub*.

4.5.3 Ten Boer, centrum

The Hub of Ten Boer (officially called: Ten Boer, Centrum) is located along the intersection where main arterial road of the village (N360) intersects with the *Gaykingastraat* going north west and the *Boltbrug* and *Boltweg* heading south east. According to the different types of Hubs defined by the policy document *Mobiliteitsvisie Groningen goed op weg* this transit node could be classified as a *village Hub*.

4.5.4 Veendam, station

Hub Veendam, station is located in the east of Veendam, separating the residential development in the west from the industrial park on the east side. It is the terminal station for the railway line Zuidbroek – Groningen According to the different types of Hubs defined by the policy document *Mobiliteitsvisie Groningen goed op weg* this transit node could be classified as a *train station Hub*.

4.5.5 Zuidhorn, station

Hub Zuidhorn, station is situated along the railway line Groningen – Leeuwarden. Originally the station was located on the northeastern edge of the town. However, due to residential expansion towards the northeast, the station has received more of a central location in the town. According to the different types of Hubs defined by the policy document *Mobiliteitsvisie Groningen goed op weg* this transit node could be classified as a *train station Hub*.

5. RESULTS

5.1 Delfzijl, station

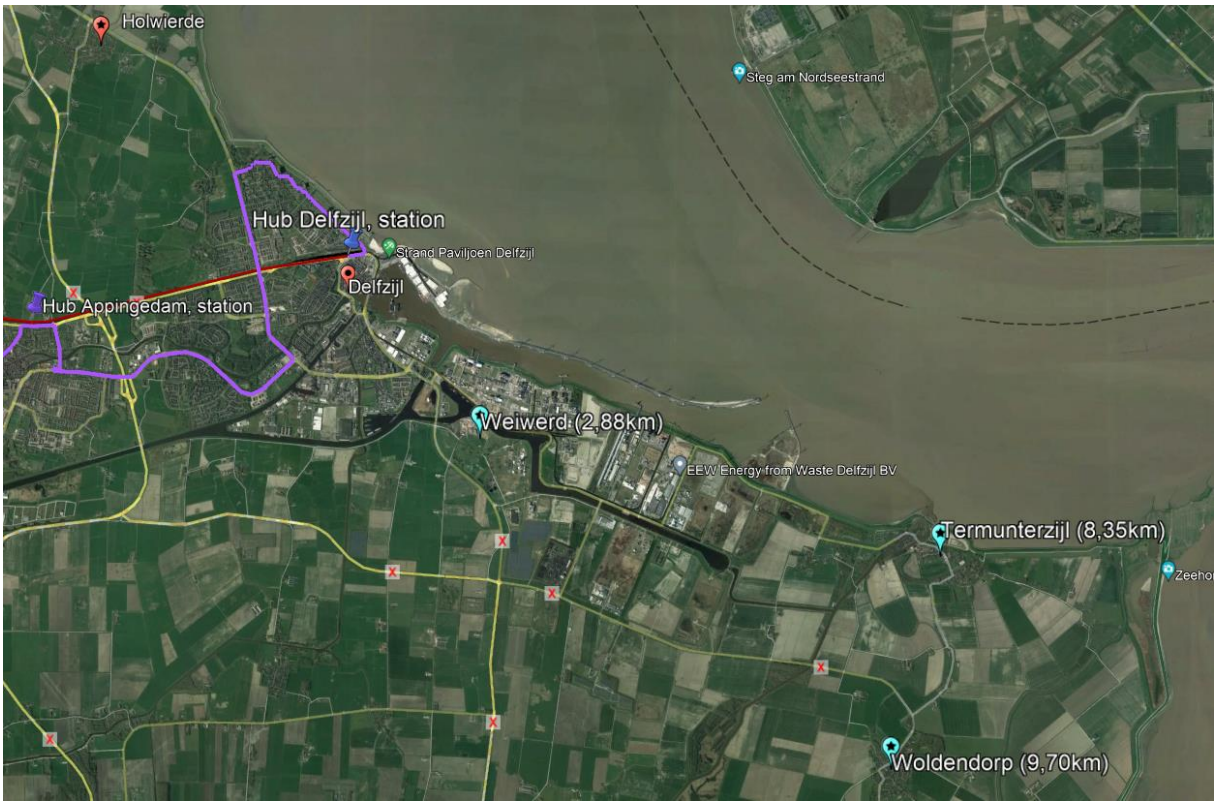

Figure 7 – Overview of area of influence of Hub Delfzijl

Most villages and towns towards the north and east are closer to Hub Appingedam, due to better road connections and in general the close proximity makes it a competitive Hub. It offers the same transportation options when it comes to day-covering transit. The area of influence on a macro scale for Hub Delfzijl therefore leans more to the south east villages. Weiwerd, Termunterzijl and Woldendorp have been recognized as rural cores that are outside of the two kilometer threshold, but lack day-covering transit.

Scale / year	**2016**	**2022**
Macro (see figure 7)	Train: half-hourly services to Groningen Bus: Variety of regional (40, 43, 61, 119 & 140) and ancillary buses (245 & 566) connecting Delfzijl, station neighbourhoods and other villages (see figure…).	Train: half-hourly services to Groningen Bus: Variety of regional (Q-link 6, 43 & 119) and ancillary buses (545 & 566) connecting Delfzijl, station with other places (see figure…).

<table>
<tr><td>Meso (see appendix A)</td><td>The Hub is surrounded by residential areas. There are undeveloped plots of land towards the north west of station, that serve no function for any other thing in the built environment. Towards the south east the centre of Delfzijl is located, with a mix of both residential and commercial development. Industrial development can be found further east along the harbour, just outside the circle of 500 meters.</td><td>Development of the empty plots just outside the 500 m radius, resulting in densification of residential areas.
New recreational zone established towards the north east of the station, next to the waterfront.</td></tr>
<tr><td>Micro (see appendix B)</td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr></table></td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr><tr><td>Bike lockers</td><td>Bike rental</td></tr><tr><td>Hubtaxi</td><td>WiFi</td></tr><tr><td>Toilet</td><td>Water tap</td></tr><tr><td>Food & drinks</td><td></td></tr></table></td></tr>
</table>
Table 4 – overview of accessibility of different levels of scale over 2016 and 2019 for Delfzijl

Concerning Macro, the public transportation connections have not changed considerably. Though it may seem that there has been a reduction in bus services at first glance, the reality is that bus routes have been combined. On an average weekday comparable connections are offered between Delfzijl and villages in its area of influence. Furthermore, no notable changes in road infrastructure for either bikes or cars was noticed. For the Meso scale, it has to be noted that some residential densification development has occurred, upon comparing satellite pictures from 2016 and 2022. Also some investments have been made in the public space, with a beach constructed along the bank of the river Ems. The most notable changes have been those on a Micro scale. First of all, the bus station has been moved slightly to where it still connects to the station, but also where it does not hinder the connection between Hub and city centre. Secondly, plenty of amenities were added between 2016 and 2022 (see table …). These added amenities have been proven valuable to a regular commuter, who will be referred to as "Dx":

> Dx: "*I really enjoy the bike facilities such as OV-fiets and the bicycle lockers. I prefer to use Delfzijl, station rather than Delfzijl, West station due to these facilities. I have been on the waiting list to access a bike locker for over a year*."

The commuter here mentions their appreciation for the facilities offered, but also that they are not accessible for them. Those bike lockers that are offered on Delfzijl are not available for them due to

high popularity. This indicates that there is a demand for safe storage options in and around Hub Delfzijl for your bike. As they mention that they have been on the waiting list for over a year, it seems that these signs are overlooked and that there is potential hidden in them. For example, more safe options for people to park their bike in Delfzijl could attract more users to travel via Hub. As mentioned in scientific literature (Garcia and Kahn, 2018) and the OV-bureau factsheet (appendix D), safety is an important factor in understand an individual's perception of accessibility.

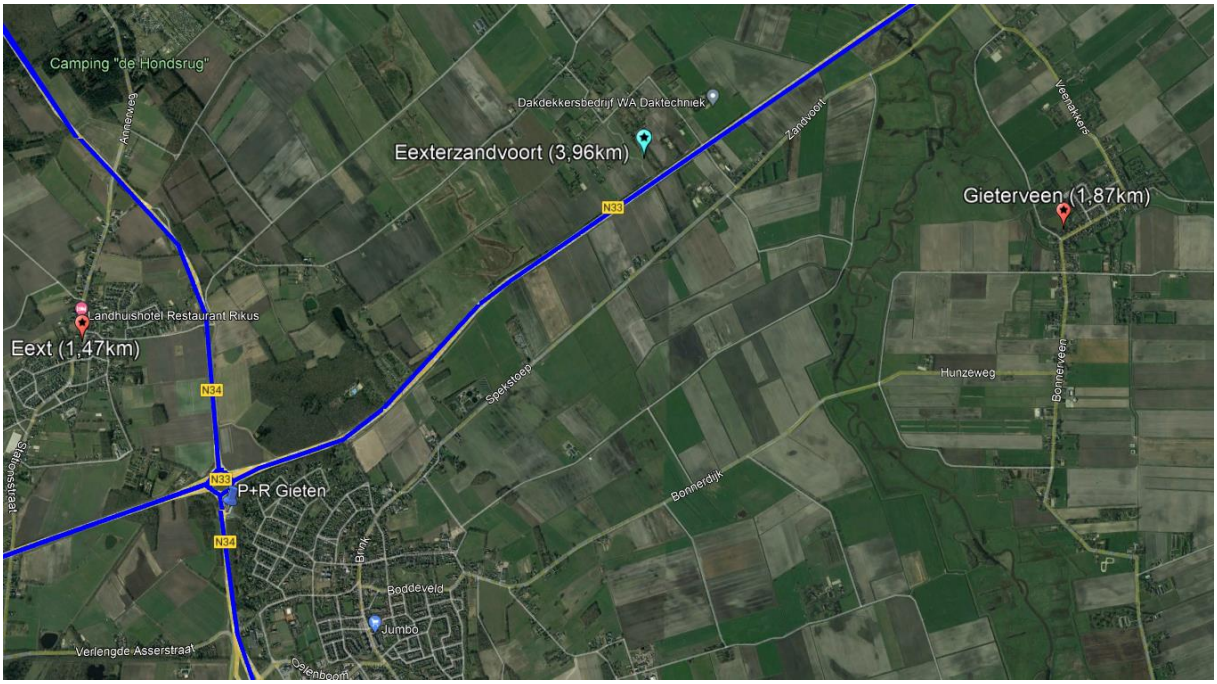

Figure 8 – Overview of area of influence of Hub Gieten

Gieten is served by day-covering bus services that depart into all different directions from the Hub. This also means that the odds are quite great that smaller rural cores close to Gieten have a day-covering service halting within two kilometres of their rural core. Only Eexterzandvoort hit the standards set for the area of influence, since other rural cores were located either closer to other Hubs or had a Q-liner bus stop near a highway exit, Gieterveen example.

Scale / year	**2016**	**2022**
Macro (see figure 8)	Bus: Two Q-liner routes that connect bigger regional cores with one another (300, 312). Multiple regional buses (28, 54, 59 & 110) provide transfers with each other and the Q-liner routes.	Bus: Three Q-liner routes that connect bigger regional cores with one another (300, 310, 312). Different regional buses (59 & 77).
Meso (see appendix A)	The village of Gieten can be found towards the south east of the Hub, with mainly residential area within the 500m circle. The shops and city centre of Gieten are located outside of this circle. There are some agricultural	For neither the industrial, commercial or residential areas can any differences be found between 2022 and 2016.

<table>
<tr><td></td><td>companies located towards the north west of the Hub.</td><td></td></tr>
<tr><td>Micro (see appendix B)</td><td>
<table>
<tr><td>Food and drinks</td><td>Bus platforms</td></tr>
<tr><td>Parking spaces</td><td>Bike shed</td></tr>
<tr><td>P+R</td><td>Bike lockers</td></tr>
<tr><td>Toilet</td><td></td></tr>
</table>
</td><td>
<table>
<tr><td>Food and drinks</td><td>Bus platforms</td></tr>
<tr><td>Parking spaces</td><td>Bike shed</td></tr>
<tr><td>P+R</td><td>Bike lockers</td></tr>
<tr><td>Toilet</td><td>Package lockers</td></tr>
<tr><td>WiFi</td><td>Water tap</td></tr>
<tr><td>Fitness</td><td>Hubtaxi</td></tr>
</table>
</td></tr>
</table>

Table 5 – overview of accessibility of different levels of scale over 2016 and 2019 for Gieten

There are some changes on Macro scale, as there are villages that lack direct connections to Hub Gieten, due to bus service changes. The trend shows that more Q-liner buses serve Gieten. These tend to skip village cores and rather halt on Hubs near highways. No changes have been found on Meso scale. The access route between village and Hub and between the regional roads and Hubs has remained the same. The changes on a micro scale are that a couple of facilities have been added, such as Wifi, a water tap, package lockers and fitness instruments. These were added on top of an already extensive set of facilities present on the Hub. However, it has to be noted that the availability of some of these facilities is limited. As respondent Gx pointed out:

> Gx: "*… I wished that the shop was open right now, it would've been nice to have drink with t his heat."*

This anecdote represents the complex situation of understanding how facilities actually benefit the experience of a Hub. For example, a score calculated by the formula's of Groenendijl, et al. (2018) would only incorporate the presence of a shop, but would not consider when it is open or closed. However, how does one even incorporate such a variable within a formula? One would then also need to know at what times such a shop is most desired to be open, since it cannot be commercially viable for shops to be open day and night unless it is located in such a busy area that it pays off, for example Amsterdam Central Station. To develop and incorporate these variables requires quite a lot of intensive and time-consuming research, which are also extremely context dependent.

5.3 Ten Boer, centrum

Figure 9 – Overview of area of influence of Hub Ten Boer

The village of Ten Boer lies along the N360 regional road, which runs parallel to the *Damsterdiep* canal. The *Damsterdiep* has been historically the link between the river Ems and Groningen. Nowadays it is mainly used for recreational purposes, as the Eems canal, which opened in 1876, provides a more direct and accessible route for industrial shipping.

Four rural cores were identified that are connected to Hub Ten Boer, centrum. However, it must be noted that each of these rural cores have a bus stop located that offers the same transit services as the Hub, being Q-link 6. These cores were included since the distance from the Hub in Ten Boer to these cores is over two kilometres long. Therefore, if a passenger depends on the Hubtaxi to reach their destination along these rural cores, they still have to travel through Hub Ten Boer.

Scale / year	**2016**	**2022**
Macro (see figure 9)	Bus: regional bus 140 and ancillary routes 564 and 563	Bus: Q-link 6 and ancillary routes 563 and 564.
Meso (see appendix A)	Residential zones on both sides of the canal *Damsterdiep*. Commercial development and shops are closeby along the *Koopmansplein*. Some more industrial areas can be found on the other side of the Damsterdiep with agricultural purposes.	Residential zone remained largely the same, with some new development added in the north end of the circle. No changes have been seen for either commercial or industrial industries.

Micro (see appendix B)	Food and drinks	Bus platforms	Food and drinks	Bus platforms
	Bike shed		Bike lockers	Bike shed
			WiFi	Hubtaxi
			Water tap	

Table 6 – overview of accessibility of different levels of scale over 2016 and 2019 for Ten Boer

The regional function of the Hub transcends beyond just the village of Ten Boer. The location of the Hub near the *Boltbrug* makes this Hub accessible to communities on the other side of the *Damsterdiep* river. Hubs are the designated transfer points in the transportation network for the *Hubtaxi* to connect with buses. These were not a service in 2016, as the Hub program was not launched yet. The villages noted with blue markers in figure … are only served by limited ancillary bus route services or none at all (Thesinge) and are quite the distance from other forms of public transportation. Therefore, these villages have been marked as within the area of influence of the Hub in Ten Boer, since travelling via Hub Ten Boer is the alternative in case no ancillary buses run. The introduction of the Hub concept therefore increased the connectivity for these villages to be reached by public transportation beyond conventional operating hours.

The bus services that connect with this Hub is Q-link 6 and ancillary bus lines 564 and somehow 563, albeit that a passenger needs to walk seven minutes to bus stop *Koopmansplein*. Q-link 6 connects Ten Boer with the city of Groningen and its suburbs on one side and Appingedam and Delfzijl on the other side, following the *Damsterdiep* river and stopping along all bus stops on the way. The amount of bus services is comparable to the bus services offered in 2016, albeit that some destinations changed of the ancillary routes.

During fieldwork an interview was held with an inhabitant of Ten Boer who lived not too far away from the Hub. The question was asked whether certain things had noticed them concerning the Hub. They stated that:

Tx: "*I did notice the new, blue sign at the bus stop, but was unsure what it really meant. … The water tap is a really nice addition. Whenever I am walking my dog I make sure to stop there and get some water for her. … Also there's this specific bench which is always occupied by 'the three gatekeepers', which is a group of three elderly men that sit there each day from 13-15. That bench came as a request from inhabitants to the municipality, after they had renovated the crossing and square. It was easy back then, to approach people from the municipality or the mayor. Not that we joined the city of Groningen, the space to interact with civil servants is less accessible.*"

These sights from the inhabitant showcase the small additions that can have a big impact on an individuals perception of a place. The water tap has proven to not only create a more accessible space for people who take the bus, but also for people who pass the Hub on a recreational basis, such as walking the dog. On top of that, apparently the Hub has been established as a place of social interaction

with help of the local government. It is an example of many ways that a Hub can facilitate bringing people together and it aligns with the ambitions set out for Hub to become spaces where people interact in different ways. This specific example came forth from residents who pushed an idea and felt free to do so because they viewed the institution that could help them reach that goal was accessible. If one wants to really understand the micro level of scale of a Hubs effectiveness, it is key to keep this line of communication perceived as accessible.

5.4 Veendam, station

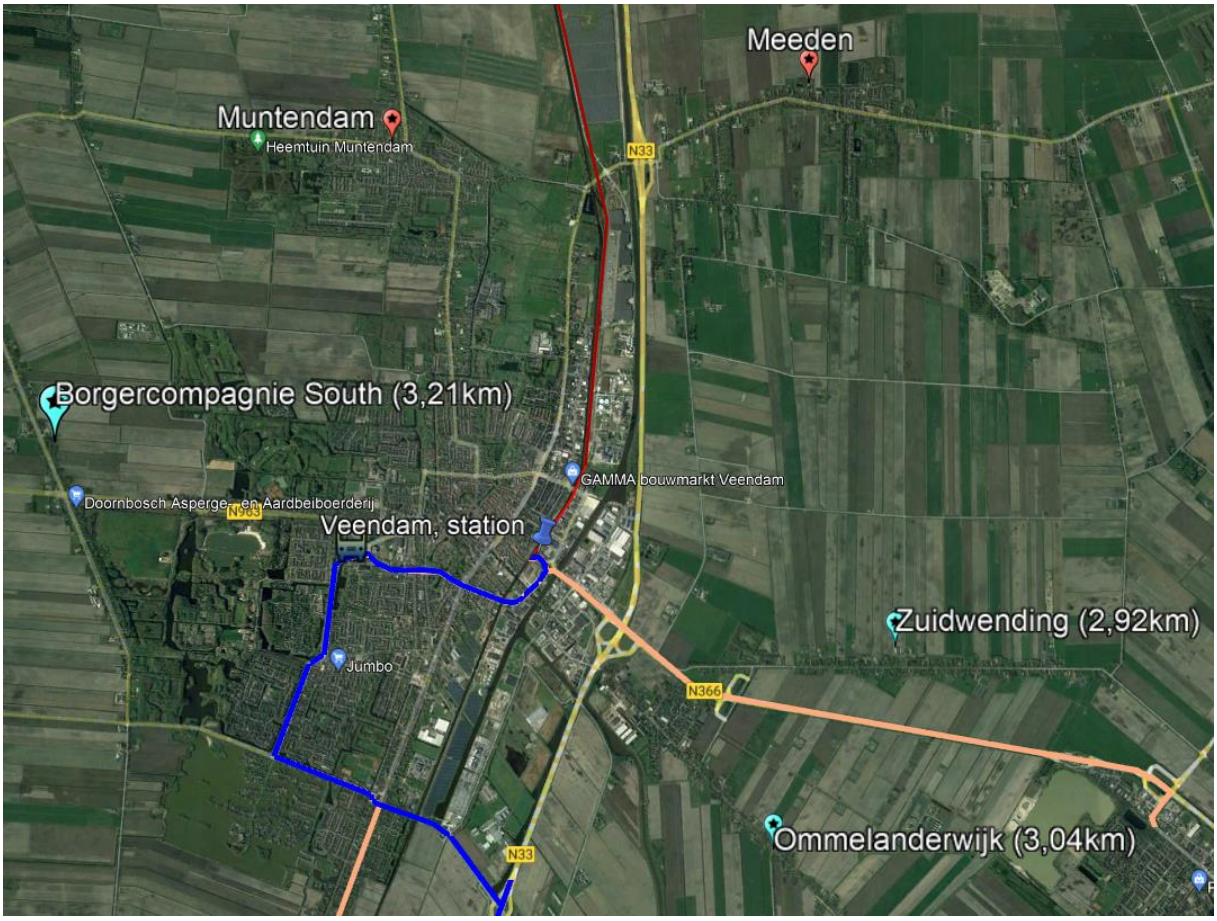

Figure 10 – Overview of area of influence of Hub Veendam

There is plenty of day-covering buses that serve villages and towns outside of Veendam. Three rural cores were identified that fit the criterium for area of influence, which are low-density, sparsely populated towns that are built in a longitudinal fashion. This also means in the case of Borgercompagnie that the south part of the town does fit in with the criteria, but the northern part not anymore due tor Hub being closerby: Hoogezand-Sappemeer.

Scale / year	**2016**	**2022**
Macro (see figure 10)	Train: half-hourly services to Groningen Bus: a variety of regional (10, 13, 110, 171 & 174) and ancillary buses (510) connecting Veendam, station with neighbourhoods and other villages (see figure…).	Train: half-hourly services to Groningen Bus: Q-liner route 310 and a variety of regional (13, 23, 71, 171 & 174) and ancillary buses (510) connecting Veendam, station with neighbourhoods and surrounding villages (see figure…).

<table>
<tr><td>Meso (see appendix A)</td><td>The Hub functions as a barrier between the residential and industrial areas of Veendam, with the former located towards the west and the latter towards the east, encapsulating the Wildervank canal. Shops and restaurant can be accessed easily walking from the Hub and can be found within the residential zone.</td><td>New development have been spotted for both residential and industrial zones, which have resulted in both densified and expanded built environments.</td></tr>
<tr><td>Micro (see appendix B)</td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr><tr><td>Toilet</td><td>Food and drinks</td></tr><tr><td>Ticket office</td><td></td></tr></table></td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr><tr><td>Toilet</td><td>Food and drinks</td></tr><tr><td>Water tap</td><td>WiFi</td></tr><tr><td>Hubtaxi</td><td>Bike lockers</td></tr></table></td></tr>
</table>
Table 7 – overview of accessibility of different levels of scale over 2016 and 2019 for Veendam

The changes in regional connectivity (macro scale) have been quite significant, with the introduction of Q-liner service. When it comes to villages served by regional buses, there has been some changes in what route serves what village, but the majority remained service. The changes on Meso scale are less significant. Empty plots of land near the Hub have received new development, densifying the area a bit more. Also some more facilities have been added, such as WiFi and bike lockers. However, the ticket office has been shut down a couple of years ago, with the empty building still being present inside the bus station. Despite the ticket office being closed, the station still seems an attraction for the tourists, since it is also the start of a heritage railway line. An employee (hererafter: respondent Vx) of the restaurant in the former station building of Veendam stated:

> Vx: "*We often get new customers that decide to grab a bit here due to it being so easily accessible. The old train line to Wildervank is a welcome facility, it is very popular for tourists*".

This is a great example of how public transportation and the built environment enforce each other by being close to one another. The Hub itself spontaneously becomes a destination since there is a facility that people want to spend time at and can easily access. Plus, the presence of the heritage railway and the restaurant also give the Hub some vibrancy in times when there are not as many commuters at the station, for example during the weekends and holidays, or during the evening on weekdays. This might not align with the functional policy goals set out for Hub, which include notions on smart, inclusive and active transportation, but it does provide an increased flow of people on the Hub and introduces people easily to the regional cultural heritage that can be found near the Hub, boosting the local economy alongside it.

5.5 Zuidhorn, station

The area of influence for Zuidhorn also focuses on three smaller cores. The Hub is also served by a day-covering bus service (39) that runs over the provincial road N… between Zuidhorn and Groningen.

Figure 11 – Overview of area of influence of Hub Zuidhorn

Scale / year	**2016**	**2022**
Macro (see figure 11)	Train: half-hourly, stopping service to Groningen Bus: Q-link 11, regional bus 39 and a variety of ancillary bus routes (30, 31, 32, 39, 637, 638) for connections to rural villages	Train: half-hourly, stopping service to Groningen, plus hourly express Bus: Q-link 2, regional bus 39 and one ancillary bus route 637.
Meso (see appendix A)	Residential zone with (semi-) detached housing situated both to the north or south of the Hub. There are plenty of commercial services available within 500 meters of the Hub. with a variety of services, such	Residential zone expanded towards the north east, partially inside the circle, partially just outside of it.

<table>
<tr><td></td><td>as a daycare, supermarket, etc. No industrial zones were noted within the circle.</td><td></td></tr>
<tr><td>Micro (see appendix B)</td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr><tr><td>Bike lockers</td><td>Food and drinks</td></tr><tr><td>Bike rental</td><td></td></tr></table></td><td><table><tr><td>Train station</td><td>Bus platforms</td></tr><tr><td>Parking spaces</td><td>Bike shed</td></tr><tr><td>Bike lockers</td><td>Food and drinks</td></tr><tr><td>Bike rental</td><td>Hubtaxi</td></tr><tr><td>WiFi</td><td>Water tap</td></tr></table></td></tr>
</table>
Table 8 – overview of accessibility of different levels of scale over 2016 and 2019 for Zuidhorn

Hub Zuidhorn, station has improved in terms of connectivity, as an express train service was added on top of the already existing train service. When addressing changes in bus service, at first glance it seems as if a great number of rural villages lost their buses due to less bus services being present in 2022. However, the scrapped buses ran limited services or consisted of services that are similar to the service that replaced the buses: the Hubtaxi. Looking at the Hub from a meso scale reveals an increase in residential development towards the north east of the station. For the added facilities, these include WiFi, Hubtaxi and a water tap. On top of this, the station received an expansion of already existing facilities, such as an increase in parking spaces and bike lockers in which one can charge their e-bikes. According to a regular visitor of the station (hereafter respondent Zx) that was interviewed; "*it is the presence of these facilities that matters the value of a Hub, not the brand*".

With the last statement of Zx in the back of our minds, which determines the importance of the facilities over the brand of the Hubs, we take a look at all qualitative interviews as a whole/ From these an interesting perspective can be drawn on the value of facilities on Hubs. On one hand, people appreciate the consistency of availability of certain facilities. However, there is another variable that seems to be valued even a bit more, which is also on a micro level of scale, but location specific. These findings could not have been done without the qualitative interviews, as the sense of appreciation could not be quantified. The fact that a facility is being used is not only relevant, but also in which context. However, this perspective lacks in the policy document explored in chapter 3.3. These reasonings are often not incorporated in policy documents, due to it being difficult on how to convert these qualitative factors into quantitative factors that represent effectiveness and performance. Nonetheless, this variable is crucial if one wants to create a space that fits well within its physical surroundings, but also its social surroundings.

Concerning the meso scale for all Hubs analysed, no real major changes have been noticed as a result of the transit Hub nearby. This is in comparison different from the public transportation services, that have seen several big changes throughout the network. This has proven that a rural built environment inherently changes far slower than an urban environment, as described by Nadeem et al. (2021). This

can be noted despite their similarities in access to public transportation or the facilities offered on such a transit node.

6. DISCUSSION

The results have highlighted the possible spatial changes for five different Hubs within their own area of influence. The comparison was made with a six year gap and on three different levels of scale: micro, meso and macro scales. The data gathered shows that there have been some changes for each scale discussed. Concerning the macro scale, there for each Hub there has been service adjustments in bus services, which included mainly the replacement of rural or ancillary services into Hubtaxi services. There were very little adjustments made to improve the objective accessibility of Hubs. There were no significant changes in roads that improved access to Hubs. However, one could argue that on one hand that Hubs, which had bus services changed over the course of six years, have objectively changed in accessibility. This change is a result of the introduction of Hubtaxi, which in certain places came as an replacement for ancillary services (Zuidhorn and Gieten), but for other areas, such as Den Horn, it made public transportation an option without the necessity to bike or walk for kilometres to the nearest transit stop. Another factor that possible could influence the objective side of accessibility could be the change in type of transit service a Hub is served with. Two of the Hubs discussed have seen the introduction of BRT-style bus services; from regular bus to Q-link in Ten Boer, and from regular bus to Q-liner in Veendam. However, it can not be said that because of this change in service that an improvement necessarily has been made for the objective accessibility of these Hubs. Objectively, Q-liner buses relatively provide faster service due to their alignments preferring highways over regional roads, and due to their speed limit being 100 km/hour rather than the conventional 80 km/hour speed limit for regular buses. Q-link on the other hand is more known to provide direct connections through the urban core of Groningen. For example, in contrast to Q-liner 310, the route of Q-link 6 became longer in comparison to its predecessor route 140 due to a diversion to serve the UMCG hospital. This diversion added a couple of minutes for passengers to reach the city centre of Groningen, but in return the bus served a mayor Hub in the urban core of Groningen, the main entrance of the university hospital. This shows that a complex decision-making process is necessary which includes a lot of different factors, in order to make the "correct" choice for the best alternative possible.

From the spatial analysis, focused in changes of the built environment focusing on the meso scale, it can be concluded that, on average, very little has changed in the past six years for either residential, commercial or industrial zones. The results reveal that, except for certain small residential expansions in Zuidhorn, Delfzijl and Veendam, no changes have happened in the built environment. Delfzijl saw an investment in public space, with the beach becoming a more attractive space for people to recreate, however the relationship between the introduction of Hub and this improvement becomes unclear. *Perhaps it was because the plans were already made before the introduction of Hub.* Nonetheless, it confirms that the Hub-concept remains a concept solely focused on mobility and that there is no organic, obvious relationship between a Hub and the built environment. The potential in combining care-free mobility and providing adequate housing cannot depend on market mechanisms, but depend on support

from governmental *triggers*. The "chicken and egg" discussion from chapter 2.3 becomes very relevant here. The value and potential in the relationship between the both is limited if the government does not take the adequate steps to make sure they reach full potential. Though, despite the investments in Hubs, they do not carry the same value as for example train stations, which have lately seen a great deal of investment in their direct surroundings due to their connectivity. However, this again is a result of governmental policies on densifying around urban cores.

Considering the micro level of scale, each Hub from the case study has seen an increase in facilities offered. Offering more facilities equates to a higher perception of accessibility, which results in a more positive score in the NPE-model. This ends up positively influencing the quality of a Hub. However, is there a link between the facilities added resulting in attracting more spatial development? In general, objective accessibility is an important factor for accelerating spatial development around Hubs in urban areas. This has to do, as we've seen from the international examples from Hong Kong and …, with the fact that these cities struggle with high population densities. Urban areas in general offer more services and facilities with a higher frequency because of this higher population density. Facilities on the Hub itself are therefore less relevant, why would one need a food and drinks shop when there is three supermarkets along the way to their Hub? Rural areas struggle to keep services within their cores and therefore one could argue that facilities are more special and therefore more appreciated.

6.1 Link to conceptual model

The conceptual model can be sectioned in to four pieces: the means to increase quality of the living environment; the assessment of a Hub's performance; the substantive factors that accomplice this assessment; and the physical results of all the efforts undertaken to change circumstances. The results will be discussed along this order of the different pieces of the conceptual model.

6.1.1 Means to increase the quality of the living environment

The concepts of active, inclusive, and smart transportation have been discussed in combination with their mentions in policy documents of all relevant governmental institutions affiliated with the Hub concept. Despite the documents being written quite recently (2021-2023), it shows the ambition that these institutions have for the future of Hubs. However, the angle through which they want to accomplish their goals seems to differ among the institutions. For example, both the municipality and province of Groningen decided to focus their ambitions of sustainable transportation through the lens of active mobility. In comparison, the province of Drenthe chose a different approach for its regional mobility plan, in which it prioritizes how motorized traffic and logistics can become more sustainable or zero-emission; seven out of eight points address their ambitions in that transition (Provincie Drenthe, 2021). Inhabitants of Drenthe are among those who drive the most in the Netherlands, indicating the presence

of FCO (CBS, 2017). However, this still relates to active transportation, since the province desires for more people to commute by bike and public transit, which includes the usage of e-bikes instead of cars. This is argued in the policy paper solely through a sustainability lens, with their main objective being the reduction of CO2 emissions (p.16). However, there is no mention of the overall health benefits that could be achieved for its population through investing in active mobility methods. That is surprising considering that Drenthe has the greatest percentage of overweight inhabitants in the Netherlands (CBS, 2021).

Notions of cycling, walking and exercise are seamlessly mentioned together with the multimodal nature of Hubs and the potential there is to combine multiple policy goals with "one" measure. The same goes for Smart mobility, where both municipality and province of Groningen expand much further on the possibilities of the future of mobility. The province of Drenthe stays rather concrete and concise on what they want to see changed. What the effects are of this difference in ambition set per policy plan on the actual performance of a Hub needs to be determined later in the future and expands the scope of this project. On one hand, an extensive and ambitious policy plan provides space for creative solutions and more bottom-up approaches to decision-making processes, gathering interest from investors. On the other hand, more concrete and simple policy plans, like the plan from the province of Drenthe, can speed up processes due to the clarity of outcomes that are desired.

6.1.2 The assessment of a Hub's performance

The perceived and objective accessibility of a Hub determines for a great matter the score of its NPE-model, which eventually reflects the performance of a Hub. The results indicate, when one compares the factors incorporated in the NPE-model from 2016 with 2022, that an improvement in the score can be noted for all Hubs due to the added facilities on most Hubs. The extent to which the scores have improved differs per Hub that has been analysed, due to one Hub receiving a greater improvement than the other. However, that also seems to be in line with certain Hubs needing more investment, due to these being rated relatively lower scores in 2016 (factsheet Hubs). There seems to be an effort to homogenize the facilities offered on the Hubs, which eventually should strengthen the entire network of a Hub. The expectation will be that people expect a certain standard of services per Hub.

6.1.3 Substantive factors for a Hub's performance

As mentioned previously, the performance of a single Hub relies on the performance of the entire network it is part of. Therefore, it is a strategic move to invest in a homogeneous set of facilities per Hub. However, the facilities offered on each Hub are also envisioned to be context-dependent. That includes the size of the Hub, its area of influence and other factors which will eventually lead to also different facilities per Hub. The handbook for Hubs offers an overview of the facilities that are expected per type of Hub. Other facilities are implemented in cooperation with local institutions. It is therefore important to incorporate the local residents too in assessing these plans, since they are not only the users

of these Hubs, but also determine the success of the place-making process, which is an increasingly relevant part of the Hub concept's ambitions. Take the elderly people in Ten Boer as an example, who use the Hub as a place to meet. This can be seen as a simple measure resulted in a Hub becoming a meeting point for residents. A more structured cooperation and communication between local governments, institutions and residents on their preferences for the Hub's environment could further enhance this place-making process.

6.1.4 The physical results of policy implementation

The rather rural state of the Hubs' surroundings appears to be quite unbothered when it comes to transformational processes such as densification or changes in land-use. in the environment like urban environments do around transportation Hubs. Based on the spatial analyses, very little land-use transformations and building density changes can be spotted along the Hubs. The built environment has not significantly been affected by the implementation of the Hub concept. For certain Hubs, more residential development emerged from agricultural land, as was the case near Hub Zuidhorn, however the densities of the buildings remained the same; (semi-) detached houses. This should not be surprising, since these villages remain rural by nature, despite being accessible via a Hub or not.

On another note, this also seems to be where there are plenty of opportunities for the interplay between the built environment and Hubs. As can be spotted in appendix A, the aerial pictures used for establishing the meso- and macro scales reveal that there is a lot of space unutilized in the (near) vicinity of the Hubs. This allows for a redevelopment of rural farmland or old industrial sights into perhaps mixed use zoning. However, is there a demand for these rural communities to grow? Is there a demand for housing near these Hubs? A lot of new questions arise when one thinks of the possibilities.

Whether the improvements done to enhance the perceived accessibility of Hubs, such as adding facilities, encourage more people to use active transportation is another question to answer. A lot of the ambitions set out in policy documents set out by governmental institutions do correlate with comparable ambitions set out through the Healthy City concept. Though, the extent to which the Healthy City concept can be applied within the Hub concept is limited, it remains relevant. Two main aspects are considered in most literature; (1) Air pollution and (2) physical inactivity, with the goal to improve living conditions in urban environments (Glazener and Khreis, 2019; Wang et al, 2022**;** Hancock et al, 2017). A network of cities established by the World Health Organization; *The WHO European Health City Network*; strives to stimulate systematic consideration of health into policy planning through collaborations of local institutions and inhabitants to create more sustainable development, with special focus on the inclusion of vulnerable populations to battle urban poverty and inequalities (Edwards and Tsouros, 2006). Air pollution is believed to mainly be a problem of urban areas (Hoffman, 2018) and the increased forecast of population growth in cities also has created an increased urgency for policy planners. Since car traffic is one of the main indicators for air pollution in urban areas (Fotopoulou et

al, 2016), a strategy fitting within the Healthy City concept would be to reduce the car volumes in an urban environment. The Hub concept interplays here by providing Park and Ride facilities on the edge of Groningen, where those arriving by car can attractively park their car and enter the urban core with public transport or bike share schemes.

6.2 Personal observations and shortcomings

All the information gathered taught me a lot on the complexity of all externalities that determine the success of the Hub-concept. In order for one to assess the effectiveness of a measure taken with the intention for a certain result to happen, an entire framework needs to be structured of all factors that could be affected by that measure. Of course, one will never be able to predict the exact outcome of a measure, but predictions can be made with high probability with the help of data. The concept of Hub, and its physical elements, was installed to, mainly, change the perception of passengers. To gather quantifiable data on people's perception is a very time-consuming and resource-intensive way to perform research. However, this type of data research is necessary to honour the complexity of the Hub-concept. This thesis strived to find an easier and more accessible method on assessing the effectiveness of Hub. At the base, the diversity in data gathered reflects properly the complexity of different types of data necessary for the assessment. There is often a lot of valuable data collected within institutions that collects dust after its original purpose. When looking at the data used in this thesis, there are two shortcomings that have to be pointed out. Firstly, the amount of qualitative data needs to expanded to properly represent the travellers' perception of the Hub-concept. to be of a bigger size than the amount of data that has been collected in this thesis to properly represent the perception of passengers. Furthermore, the qualitative data have only been gathered from 2022, since no qualitative data could be found on this matter since 2016. Therefore the extent to which they can compare with their perception of a transit node is limited. During the collection of data, it was not a requirement set out whether the respondent actually used the transit stop already in 2016.

Another shortcoming is the short times in between moments that data was collected. From the results it is visible that not many things have changed in the built environment, therefore perhaps a longer gap between the data collection could provide more significant results. This can also be seen as a reminder for the area in which the research was performed.

7. CONCLUSION

7.1 Answers to sub-questions and research question

SQ1: What were the initial goals and expectations by policymakers that justified investment for the Hub concept in Groningen and Drenthe?

The goals and expectations have been altered over the course of time. The Hub-concept initially started off as a means to create more efficient travel patterns by investing in strategically located nodes. Eventually, it evolved into an ambitious project with bigger aspirations concerning customers satisfaction and overall experience. The initial components of the intervention were prospected to result in a reduction in exploitation costs, not only as a result of investments made in the built environment, but also by prioritizing bus routes with a higher average speed (Q-link and Qliner) by investing in infrastructure for those routes accordingly. These investments were expected to make a return, as more passengers would be lured to make use of the service due to the reduced travel time and enhanced experience on the Hubs. On top of this, it caught the attention of regional institutions that this mobility concept could also help fulfilling policy goals set out concerning sustainability, health and inclusivity. All three policy papers that were affiliated with the concept discussed in this thesis had multiple mentions of Hubs spread across multiple themes.

SQ2: How does scientific literature on Hubs in an urban context relate to Hubs in rural surroundings?

Scientific literature on hubs in an urban setting tend to analysis on more up-close, smaller scales. As described in chapter 2.3 by Basheer et al. (2020). An analysis method was used in that study on a scale that fit with an urban context. A radial measure was used to determine the catchment area of a hub and thus on what part of the urban built environment it was believed to have an impact on. A similar approach has been used in this thesis, by drawing a circle around a Hub to investigate the meso scale of accessibility. That measure of scale is strong enough as a determination of effectiveness due to the density of development surrounding the hub. The macro scale added in this thesis has been proven necessary to fully understand the entirety of accessibility for a rural Hub, as distances for access to mobility simply are greater and population densities are far lower. The goal of a Hub in essence differs between a rural hub and an urban one: the urban one seeks a hub as a means to deal with rising population numbers and the mobility demands that arrive as a result of it. On the contrary, a rural hub, specifically in Groningen and Drenthe context, is installed as a means to keep transportation accessible to all in an environment where population densities tend to decline.

SQ3: What spatial changes have occurred within the area of influence of Hubs?

From the spatial analysis performed on meso scale it can be concluded that there have been little to no spatial changes in the built environment of the Hubs that have been taken a look at in the period between 2016 and 2022. For two locations that were analysed in the period new residential development was noted within the 500 meter radius, but it cannot be concluded whether this can be attributed to the rebranding of the train station to a Hub. The reason for the lack of other development around the hubs can perhaps be explained by the rural nature of the locations in which the analysed Hubs were located.

SQ4: What improvements have been made concerning the accessibility of Hubs?

The Hubs have received a more homogenized set of facilities, which improved the sense of a network of Hubs. This mainly improved the sense of perceived accessibility for passengers who use public transportation in Groningen and Drenthe, as it has become clearer now on what to expect on a Hub as a passenger. For objective accessibility, there has been a single example where accessibility has improved, being Delfzijl, station. This was done by creating a more pedestrian-friendly entrance to the station with added facilities and an updated appearance. Nonetheless, this is rather "catching-up" to the standards of the other Hubs, which had a better standard of accessibility to begin with.

RQ: What is the relationship between Hub investments and the spatial development within a Hub's area of influence?

Based on the findings in the data collected in this thesis it seems too early to determine the state of the relationship between investment in Hubs and the hypothetical investment in the area of influence of the analysed Hub. The investments in facilities on Hubs have shown to enhance the experience of those who use public transportation to get around. Plus, an increase in bus services and connectivity of the system does make for a better accessible system on one hand. However, to state that this increase in accessibility has a direct impact on the built environment is too early to tell.

7.2 Recommendations and reflections.

Therefore, it is recommended for future research endeavours on this relationship. that the six year gap that has been used in this thesis is to replaced by a longer period, for example to ten or fifteen years. The six year comparison has been proven to be too little time to measure the effect of an intervention taken. Another recommendation for future research is including the different levels of scale when considering the effect of a measure. This creates a clear and detailed overview of all spatial layers that an intervention can have an impact on. Furthermore, a helpful tool to create a basis for future, qualitative comparisons, would be to incorporate the local communities within future development plans for Hubs. This group is familiar with the area and its needs and therefore they can provide the crucial, location specific qualitative side to the effect evaluation, that this far has pre-dominantly existed out of quantitative data.

Furthermore, I reflect back on this thesis on a process that has taught me a lot and sometimes challenged me a bit too much. The complexity of a user's perception of Hub is a lengthy process that needs care,

consistency and a lot of manpower to deliver properly. Due to personal circumstances, it took longer than anticipated to finish this project and to grasp that desired consistency of research. However, I do believe that this paper will contribute to the acknowledgement that transit based solutions as Hubs can be and have to be executed more with the people than rather just for the people if policy makers want it to be a success. Public transportation should be more at the heart of a community, both physically and emotionally. I was grown up with that believe, as the metro ran right through the core of the neighbourhood I grew up in, but also carried meaning in our local culture. The metro even had an album named after it by a local group of rappers. For transit to become so culturally established, it needs to go through a process that simply takes time.

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Appendix A – Meso scale aerial pictures of Hubs (source: Google Earth)

Delfzijl -2016

2022

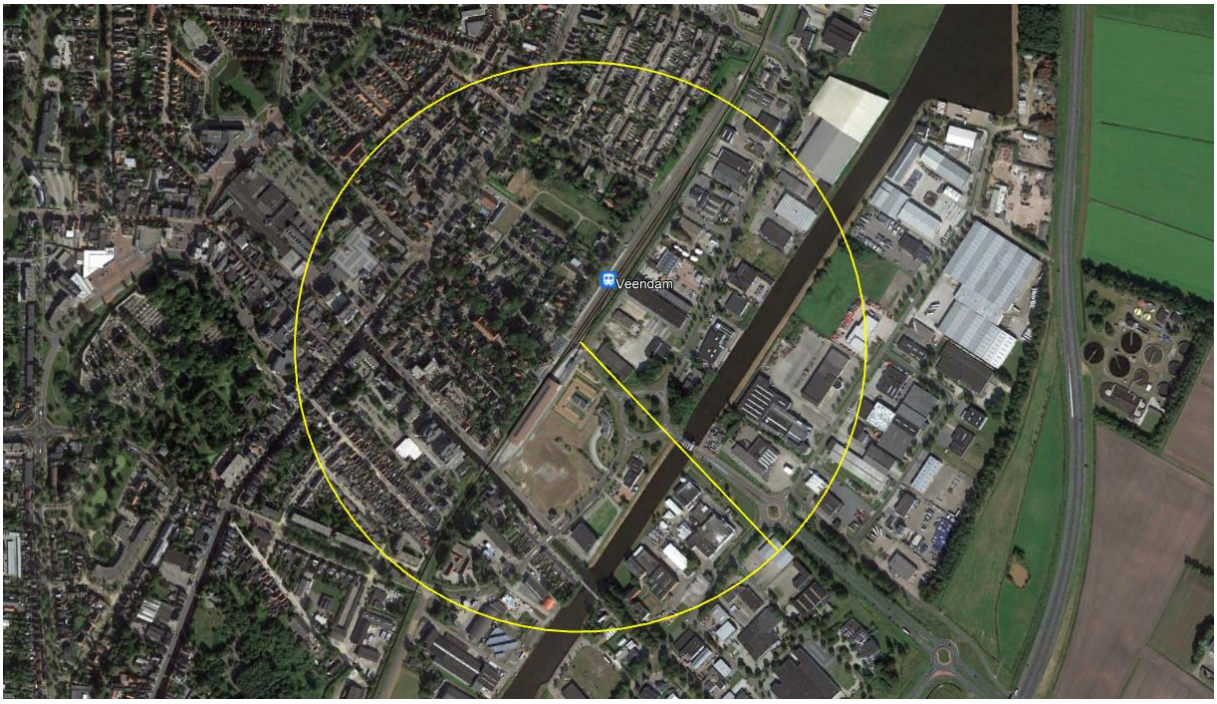
Gieten 2016

Gieten 2022

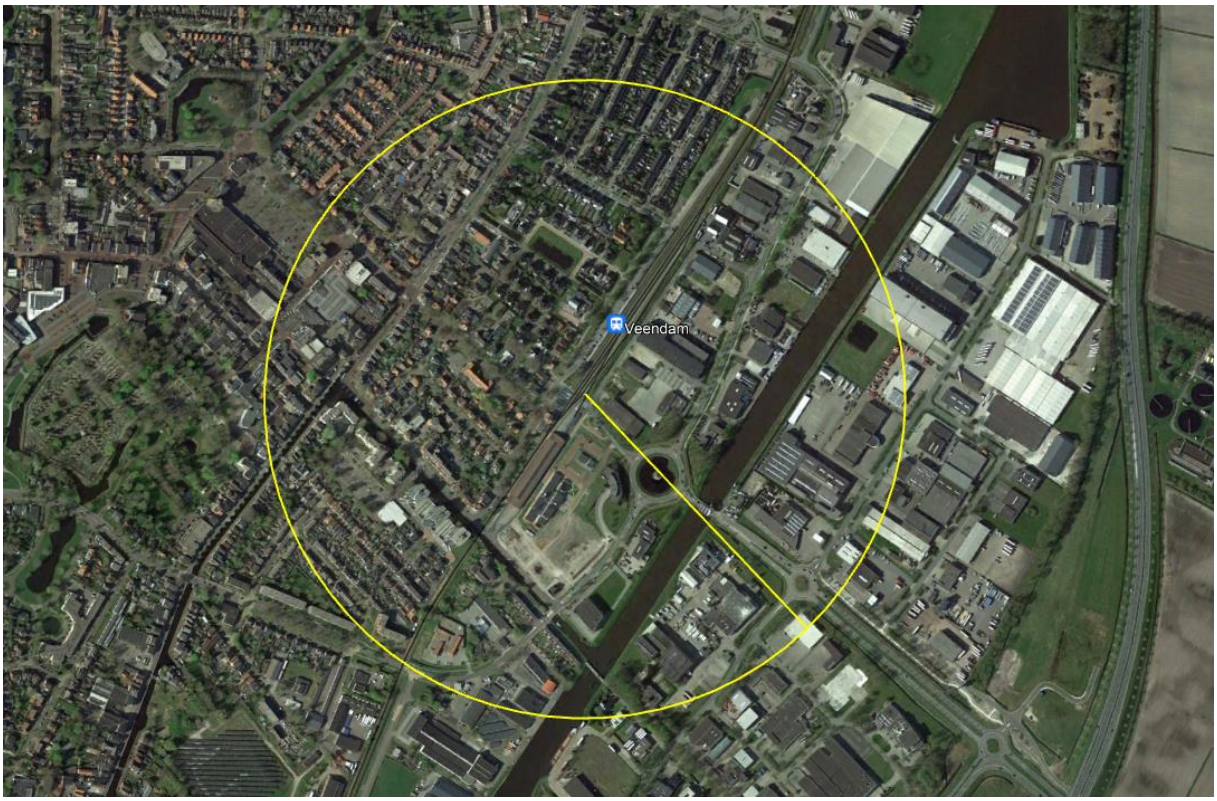
Ten Boer - 2016

2022

Veendam - 2016

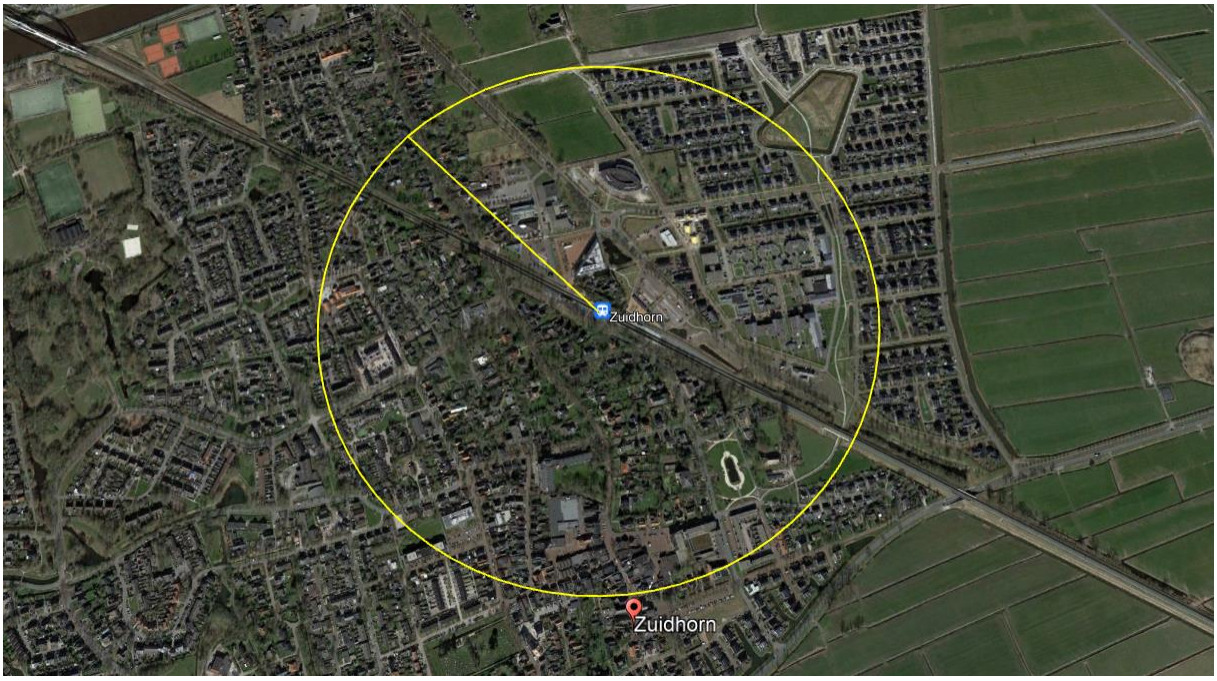


2022



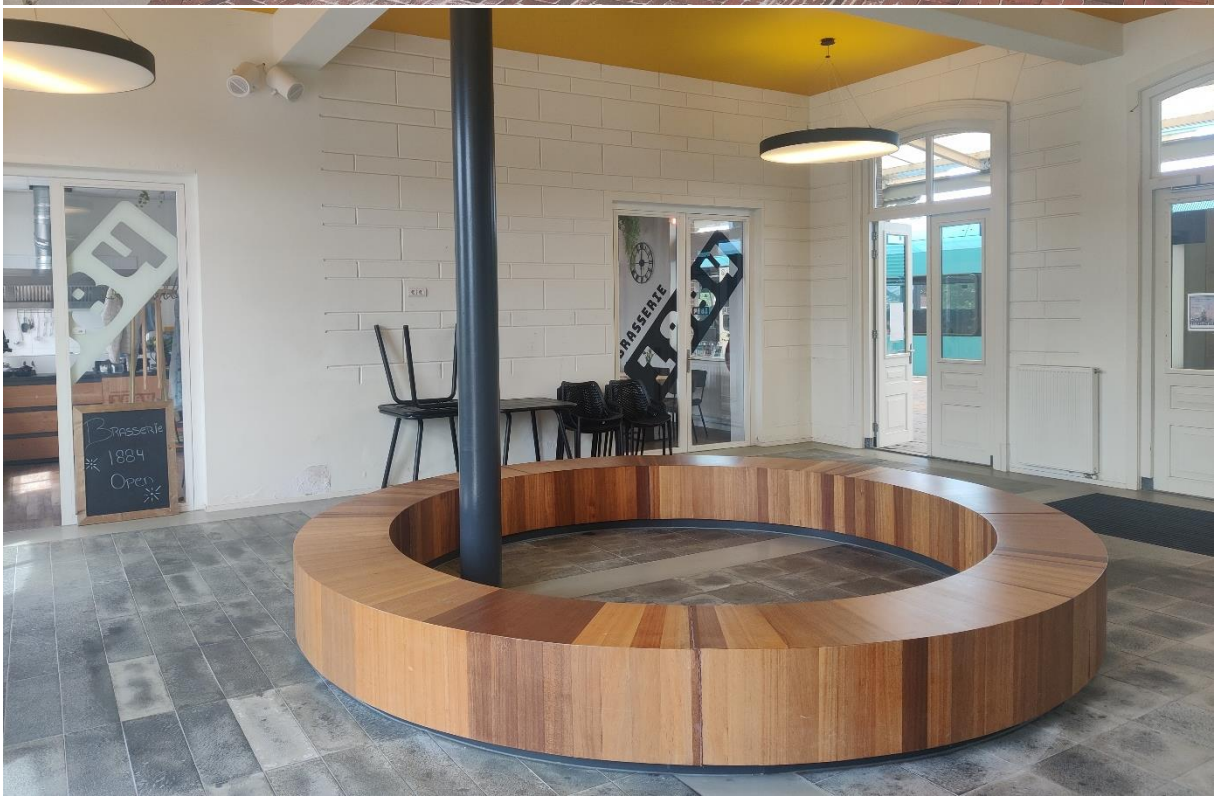
Zuidhorn -2016

2022



Appendix B – Micro scale aerial pictures of Hubs.

Delfzijl (2022)




hub
link

Gieten


Laat hier 24/7
je pakket bezorgen!
hub

Ten Boer

Veendam


VEENDAM

Zuidhorn


EETHUIS 3e PERRON
COFFEE-TO-GO
EETHUIS 3e PERRON
EETHUIS 3e PERRON


VRIJDAG
2 SEPTEMBER
ZATERDAG
3 SEPTEMBER
TIMMIE TIROL
Sam Louis & MC Voogd
PARTY ANIMALS
Donnie & De Freshmaster
LOCAL HEROES
GROOVE ALLY
RAMBLIN' BOOTS
Mama Mafia
ALLOWAY
WWW.KANAALPOP.NL
STEDON


Deze fietskluis
hub
Zuidhorn
1
Zuidhorn
2
Zuidhorn
3
Zuidhorn
4

Appendix C

Type of evaluation	Features / criteria
Real control group, pre- and post-test	Experimental evaluation form in which a pre- and post-test is applied and which groups are randomly assembled. This set-up includes both an experiment group as a control group. R O X O R O O
Real control group, post-test only	Experimental evaluation form in which only a post-test is applied and whose groups are randomly assembled. This set-up includes both an experiment group as a control group. R X O R O
Non-equivalent control group pre- and post-test	Experiment evaluation form that is very similar to the 'real control group, pre- and post-test'. The only difference is that this evaluation form the groups are not randomised. O X O O O
Experiment group, pre- and post-time series analysis	Experimental evaluation form which includes a measurement at different time intervals. This involves several pre-tests and post-tests in order to make trends an autonomous developments visible. O O O X O O O
Time series analysis with non-equivalent control group	Experimental evaluation form which is similar to the 'experiment group, pre- and post-test time series analysis'. The only difference is that this form also includes a control group next to the experimental group. O O O X O O O O O O O O O
Effectiveness research	Effectiveness research that combines some strengths of effect- and goal-achievement research. As an attempt is made, as in the effect research, to find out the influence of the instrument empirically. In addition, as with goal-achievement research, explicitly the link is made between the goals of the policy.
Effect research	Disadvantage of both the situation research and the goal-achievement research is the uncertainty about the contribution of the instrument to the observed change. In effect research this is encountered by adapting the 'with-without' approach (comparing the situation 'with' the use of the instrument and the situation 'without' the use of the instrument).
Goal-achievement research	Establishing a relationship between what is pursued with an instrument (goal) and what has been achieved.
Situation research	Primary mapping changes made in the policy area in which no specific goals are expectations are established.
Intuitive research	Evaluation based on tacit (implicit) knowledge and common sense.

Appendix D – overview of scores given for hub Delfzijl based on different themes and factors

Delfzijl 2019

ov bureau groningen drenthe

Modaliteit, reismotief en persoonskenmerken*

	Modaliteit		Geslacht en leeftijd	
28%	lopend		38%	61%
34%	fiets,bromfiets, scooter			
9%	auto als bestuurder		Geslacht overig	1%
6%	auto als passagier		12-20 jaar	57%
23%	bus		21-40 jaar	27%
-	trein		41-60 jaar	12%
-	taxi		>60 jaar	4%
	Reismotief		**Reisfrequentie**	
23%	werk / zakenreis		≥ 1x per week	79%
68%	studie / school		< 1x per week	21%
8%	sociaal-recreatief			

* bovenstaande percentages zijn m.u.v. ontbrekende gegevens

Thema's en items	Dit knooppunt Q2 2019	Dit knooppunt Q4 2016	Verschil
Algemeen oordeel hub	**6.5**	**6.1**	**+0.4 ****
Wat is uw algemeen oordeel over dit (bus)station	6.8	6.3	+0.5 **
Wat is uw algemeen oordeel over de fietsenstalling bij deze hub	6.2	5.7	+0.5 **
Wat is uw algemeen oordeel over de parkeergelegenheid bij deze hub	6.0	5.8	+0.2
Wat is uw algemeen oordeel over de looproutes op deze hub	7.2	6.5	+0.7 **
Sfeer	**5.5**	**4.4**	**+1.1 ****
Ik ervaar deze hub als sfeervol	5.5	4.5	+1.0 **
Ik vind dat deze hub een warme uitstraling heeft	5.5	4.3	+1.2 **
Ik vind deze hub kleurrijk (niet in thema sfeer)	5.2	4.2	+1.0 **
Comfort	**6.4**	**5.7**	**+0.7 ****
Deze hub voldoet aan de hedendaagse wensen en eisen	6.7	6.0	+0.7 **
Ik ervaar het wachten op deze hub als comfortabel	6.2	5.3	+0.9 **
Ik ervaar voldoende beschutting tegen het weer	6.4	5.8	+0.6 **
Toegankelijk	**7.5**	**7.0**	**+0.5 ****
Ik vind deze hub makkelijk bereikbaar	7.8	7.7	+0.1
Ik ervaar de directe omgeving van deze hub als prettig	7.2	6.3	+0.9 **
Ik heb een goed overzicht op deze hub	7.5	7.2	+0.3
Ik vind de informatie op deze hub duidelijk	7.4	7.0	+0.4
Veilig & schoon	**6.7**	**6.4**	**+0.3 ***
Ik voel me veilig op deze hub	6.8	6.7	+0.1
Ik ervaar deze hub als net en verzorgd	6.9	5.9	+1.0 **
Ik ervaar het gedrag van andere mensen op deze hub als prettig	6.8	6.2	+0.6 **
Ik ervaar deze hub als stil (geen hinderlijk geluid)	6.4	6.7	-0.3
Beleving	**6.5**	**6.0**	**+0.5 ****
Ik voel me prettig op deze hub	6.6	6.2	+0.4
Ik voel me ontspannen op deze hub	6.4	6.1	+0.3
Ik voel me welkom op deze hub	6.4	5.6	+0.8 **
Extra vragen fasciliteiten 2019			
Ik ben tevreden over de faciliteiten op deze hub	6.1		
Wat is uw algemeen oordeel over de faciliteiten op deze hub	6.2		

significante verschillen: ** p ≤ .05 | * p ≤ .1

	Q2 2019	Q4 2016
steekproef (n=)	139	209
ochtend/ middag (n=)	116 / 0	112 / 98
trein	ja	ja
bus	ja	ja
taxi	ja	ja
hubtaxi	ja	
P+R	ja	nee
Kiss & Ride	nee	
fietsenstalling	ja	ja
fietskluis	ja	ja (2018)
OV-fiets	ja	ja (2018)
afstand tot bus vanaf		
parkeren	lang	middel
fietsenstalling	middel	middel
treinstation	kort	kort
WiFi	ja	nee
Toilet	ja	nee
Watertappunt	ja	
Horeca	ja	nee
Fitness	nee	
aantal reizigers		
bus (instappers per jaar)	57291	63849
bus (uitstappers per jaar)	56527	55400

Appendix E – Overview of questions asked during qualitative interview

Q1: Are you a regular user of this Hub? If so, for how long?
Q2: What is your main reason for travelling via this Hub?
Q3: Are you familiar with the concept of Hub?
Q4: Have you noticed any changes since 2018, when this concept was launched and this stop was "transformed" into a Hub?
Q5: Have there been any facilities in particular which you enjoy while making use of this Hub?
Q6: Are there any other things you would like to share on this topic?