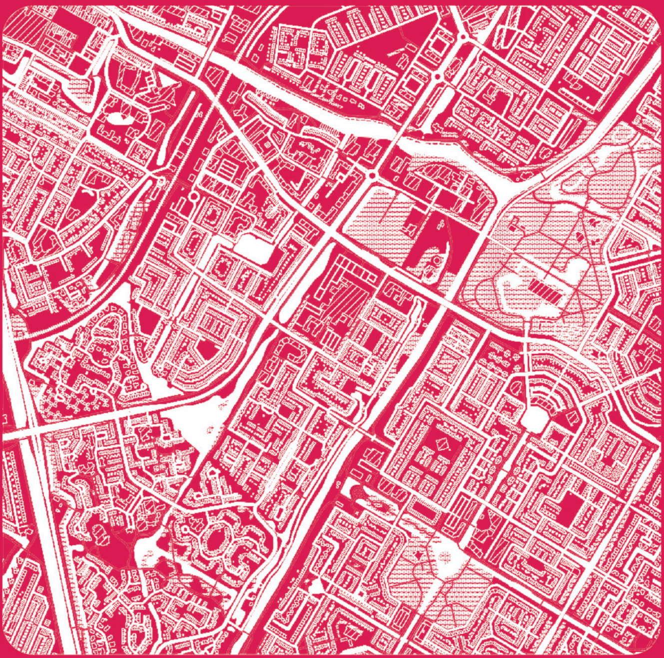



DEMOGRAPHIC CHANGES IN DUTCH NEW TOWNS

THE EFFECTS ON FACILITIES AND BUILT ENVIRONMENT

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6804543

MASTER THESIS
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UTRECHT UNIVERSITY

Maps on the front from left to right:
Neighbourhoods Purmer-zuid and Gors - *Purmerend*
Neighbourhood Houten-noord - *Houten*
Neighbourhoods Schollevaar-noord and Schollevaar-zuid - *Capelle a/d IJssel*
Neighbourhood Almere Haven - *Almere*
Neighbourhoods Sterrenkwartier, Gildenwijk, De Hoek, Waterland, and De Akkers - *Spijkenisse*

Source: Maps.Stamen, 2023

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Demographic changes in Dutch new towns and the effects on facilities and built environment

What are the changes in the demographic makeup of households in Dutch new towns, such as age and household composition, and how do these changes affect the built environment of these areas?

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Number of words: 23.700 (excluding references and tables)

I PREFACE

The subject I am delving into has an intriguing nature that fascinates me. It revolves around the understanding that what was once considered groundbreaking in the realm of spatial planning has undergone significant evolution - Groeikernen. Cast your mind back to the 1980s when developers and planners were resolute in their convictions, firmly believing that their approach to town development represented the greatest living environments of all time. They were convinced that their strategies perfectly aligned with the desires and aspirations of the people they served. Reflecting on this, it begs an interesting question: can we apply a similar perspective to the neighbourhoods we are building today?

For me, the charm of spatial planning lies in the inherent beauty of how places age. I hold a firm belief that the process of transformation contributes significantly to the overall appeal of this fascinating field. Streets, neighbourhoods, and cities are living entities, forever in motion. They are constantly adapting and discovering their ideal mode of functionality within the ever-shifting dynamics of each day. This never-ending journey of refinement and adaptation fascinates me, serving as a source of admiration and inspiration. I am continually mesmerized by how these places evolve and find their distinctive character, harmonizing with the needs and aspirations of the communities they hold.

I want to thank everyone at Studio Bereikbaar for their insights and assistance throughout the writing process of this thesis. In particular, a big thank you to Isabel Liedtke for her time to guide me and provide me with useful feedback. I also want to thank Yanliu Lin for the possibility to meet frequently and for the great feedback during this research. It significantly enriched the quality of this work. Lastly, I would like to thank all those who patiently listened to my extensive discussions on Dutch new towns and shared my enthusiasm throughout this thesis. Your support and willingness to engage in these conversations have been truly invaluable to me.

Figure I: Doorslag in Nieuwegein

Source: Own research, 2023

II ABSTRACT & GLOSSARY

ABSTRACT

This research examines the changes in household demographics, age, and population in Dutch new towns and their implications for the built environment. The study investigates how household demographics and population dynamics evolved in Dutch new towns. How the changing makeup of households and age demographics affect facilities within new towns. And how the changing makeup of households and age demographics impact the spatial and physical aspects of new towns.

The findings reveal diverse population dynamics across new towns, influenced by governmental growth strategies. Household sizes have decreased, and the population has aged at a faster rate compared to the Netherlands. The regressions reveal that facilities are influenced by demographic changes. This holds true for both new towns and the entirety of the Netherlands. However, the demographic shifts in new towns are a lot more more substantial. The abundance of single-family homes and the rapid construction of homes within a condensed timeframe have resulted in a large influx of a homogeneous population. Consequently, the facilities experience much greater fluctuations in demographics in new towns, leading to a mismatch in facilities, as well as in the physical space.

Overall, this research contributes to understanding the changes in household demographics and their effects on the built environment in Dutch new towns. The findings provide insights for future developments and policy recommendations, enhancing liveability and meeting the needs of changing populations.

GLOSSARY

Groeikern	A "groeikern" refers to a designated area or village selected for rapid growth and development as part of a centralised planning strategy in the Netherlands. It can be compared to new towns in the global context.
VINEX	VINEX stands for "Vierde Nota Ruimtelijke Ordening Extra" in Dutch, which translates to "Fourth Memorandum on Spatial Planning Extra" in English. It was a major spatial planning policy introduced in the Netherlands in 1991. VINEX resulted in the development of several large-scale residential areas, often located on the outskirts of existing cities.
NOVEX	NOVEX stands for "Nationale Omgevingsvisie Extra" in Dutch, which translates to "National Planning Act Extra'" in English. It is part of a long-term national vision for the Netherlands, which provides guidelines and policy objectives for sustainable spatial development. NOVEX areas are selected areas for urban expansion and transition, and housing development.
Bundled deconcentration	"Bundled deconcentration" is a planning concept that originated in the Netherlands. It refers to a strategy of concentrated urban development and expansion in selected municipalities or areas, known as "groeikernen" or new towns.
TOD	TOD stands for Transit-Oriented Development. It is an urban planning approach that promotes compact, mixed-use communities designed around public transportation stations.
NU	NU stands for New Urbanism. New Urbanism is a design and planning movement that promotes the creation of walkable, mixed-use neighbourhoods with a range of housing types, public spaces, and amenities. It emphasizes human-scale development, community engagement, and sustainability to foster vibrant and cohesive urban environments.
MHSP	MHSP is an abbreviation of the Dutch Ministry of Housing and Spatial Planning. This ministry existed at the time when the Dutch groeikernen were designed and planned.

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1. INTRODUCTION

In the Netherlands, the growth of urban and suburban regions is truly integrated with spatial planning. The concepts of "groeikernen," or the more known term "new towns" were first addressed in a new spatial planning policy that was published by the Ministry of Housing and Construction in 1960. The name of this regulation is "Nota Inzake de Ruimtelijke Ordening," or "Spatial Planning Memorandum." The Dutch government produced the "Tweede Nota Ruimtelijke ordening," or "Second Spatial Planning Memorandum," not long after. The "groeikernen" guiding ideas were outlined in these two policy documents. This method of planning was known as concentrated deconcentration. This planning principle selected various municipalities to expand. The Second Spatial Planning Memorandum described the "groeikern" as a village that must experience rapid growth, particularly for the benefit of a neighbouring city, if this growth is disproportionately big compared to the size of the town itself. Fifteen villages around the Netherlands were selected for this concentrated deconcentration idea.

Back in the 1960s, Dutch cities were expanding quickly. Large-scale urbanisation was something the Dutch government intended to avoid because they thought it had negative effects on the liveability of the country. That was the major justification for the "concentrated deconcentration" programme in the beginning. The Dutch government recognized the need for a more organized and controlled approach to urban development, and developing new towns was seen as a way to achieve this. A Dutch new town consisted of a designated area designed for urban expansion and development, usually located near transportation hubs such as railway stations or metro networks. These areas were planned to include residential and commercial uses, to create self-sufficient villages. The new towns lacked job opportunities because they were still heavily focused on the adjacent cities. The top-down planning was in contrast with the sprawling and unplanned growth happening in many cities at the time. The large housing stock of single-family dwellings with individual gardens made the new towns particularly popular for families. Overall, the new towns were an important part of the planning context in the Netherlands in the 1970s and helped shape the way agglomerations were developed and managed in the country. The concentrated deconcentration approach was gradually phased out in the "Fourth Spatial Planning Memorandum." This happened because of numerous unfavourable consequences that were directly attributed to this policy. The new towns are still a favourite among families today. However, the number of households with children has decreased, while the number of households without children has increased. The new towns also experience severe ageing, due to the families that moved there in the 1980s getting older. The children often move away to the adjacent cities. New towns may experience issues as a result of this. Elementary schools need to adjust, healthcare facilities need to be modified to meet the needs of the elderly, and so on.

1.1 Problem definition

In former Dutch new towns, the number of households with children is currently declining. To give some context on this issue, I compared data from a list of randomly selected postal codes inside those new towns.

Figure 1.1: Dutch new towns and their adjacent cities

Source: Own research, 2023

Table 1.1 shows that the reduction in households with children is substantially more profound than it is for Dutch households in general. The former new town of Utrecht, Houten-Noord (3993), stands out among these randomly chosen postal codes. There has been a reduction in the number of households with children in this neighbourhood by more than 20%. Research on this issue is necessary to determine whether the neighbourhood will experience any consequences from the decline.

According to the population pyramids, these smaller household sizes are mostly the effect of older couples that do not have their children living at home anymore. If the decline is driven by older couples staying in single-family homes, they may be less likely to engage in physical upgrades or renovations to their homes. This can result in a physical environment that is ageing and in need of maintenance, which can impact the overall appearance and appeal of the new towns. Additionally, as these older couples age and their health declines, they may require special accommodations, such as wheelchair ramps or grab bars, which can alter the physical environment more permanently. Next to physical changes, there can also be a change in facilities. For example, closing schools due to less demand for school-aged children. Or more health facilities that are focused on the elderly. Other existing facilities can change due to the changing household size, such as retail space, cafeterias, and recreation. All these factors need to be considered when researching this topic.

1.2 Knowledge gap

Changing household composition in neighbourhoods over time is not something that has been widely researched. Often research talks more broadly about demographic changes within neighbourhoods but does not connect it with spatial effects (e.g., Elzerman & Bontje, 2015; Sarzynski & Vicino, 2019). In research from Sinclair (2004), spatial developments are shortly talked about in relation to household size, however, this is dated and focused on the North American context. There has also been a lack of research on how these changes affect those neighbourhoods (Țăruș et al., 2022; Feijten & van Ham, 2009). Besides the fact that there is little research on demographic changes and how it affects neighbourhoods, there is no scientific research on the changing household compositions in Dutch new towns specifically. This results in a theoretical knowledge gap (Miles, 2017). Furthermore, there is no research on household composition in combination with large-scale residential development. This can be seen as a practical knowledge gap because practice is not covered by existing research (Miles, 2017).

In addition to the theoretical gap in the literature, the Dutch environment itself makes research findings more context-dependent. Due to the principles underlying the "groeikernen" strategy, the Dutch situation in this instance is distinctive. The outcomes of this study should be applied to the next significant construction projects, which are also related to the practical knowledge gap.

Table 1.1: Changing household composition in Dutch new towns

	2000		2022	
Neighbourhood (postal code)	Households with children	Households without children	Households with children	Households without children
Houten, Noord (3993)	57%	43%	36%	64%
Spijkenisse, De Akkers (3204, 3206, 3208)	47%	53%	37%	63%
Almere, Bloemenbuurt (1338)	47%	53%	43%	57%
Duiven, Zuid (6992)	48%	52%	38%	62%
Nieuwegein, Batau (3437)	40%	60%	34%	66%
Purmerend, Purmer-Zuid (1447)	54%	46%	42%	58%
Dutch average	36%	64%	32%	68%

Source: CBS Statline, 2022b

1.3 RESEARCH QUESTIONS & OBJECTIVE

Considering the research gap in this field and the conclusions that follow the main research question is as follows:

What are the changes in the demographic makeup of households in Dutch new towns, such as age and household composition, and how do these changes affect the built environment of these areas?

This main question is an explanatory knowledge question because it intends to demonstrate how this event of changing households develops, and how it originated and changed (Verschuren & Doorenwaard, 1999). To elaborate on the research question, I proposed three sub-questions:

1. How are the different Dutch new towns developing in household and age demographics, and what are the main factors of change?

2. How does the changing makeup of households and age demographics affect the facilities in new towns?

3. How does the changing makeup of households and age demographics affect the spatial and physical conception of new towns?

I first wish to comprehend how all those new towns altered throughout time to accomplish this research goal. What do the population dynamics look like in Dutch new towns, and why are they happening? It is interesting to see if any strategies resulted in the fact that there are changing population dynamics.

Once the reasons behind the changes occurring in different neighbourhoods are understood, it becomes essential to explore the potential effects of these changes. These effects can be observed in the changing facilities within the neighbourhood (e.g., fewer or more schools/daycare, increased healthcare services for the elderly, and changes in retail to accommodate shifting demand). Understanding these effects is crucial in comprehending the dynamics and implications of the evolving household demographics on the overall fabric and liveability of the neighbourhood.

As noted in sub-question two, neighbourhoods may undergo repercussions on facilities. But, they might also undergo spatial repercussions. For example, outdated playgrounds, accessibility of apartments, and wheelchair ramps. Sub-question three will answer these spatial repercussions. The spatial effects that result from the changing makeup of household demographics form interesting findings for future neighbourhoods, but also for current policy recommendations.

These findings are relevant in future developments and neighbourhoods that are prone to the same effects. The VINEX locations, for instance, were constructed more recently. There might be some factors that influence household composition that is also possible in other large-scale residential developments. It is necessary to address the new town's negative impacts and to prevent similar ones from occurring in the future in other Dutch neighbourhoods. This will be explained in the next paragraph.

1.4 RELEVANCE

The relevance of this research is distinguishable in social and scientific relevance. First, the societal relevance is discussed and after that the scientific relevance.

1.4.1 SOCIETAL RELEVANCE

The new towns in the Netherlands have almost 1.5 million inhabitants, approximately 8% of the total Dutch inhabitants. This means that the findings of this research are relevant to a large group of Dutch citizens. Dutch new towns often suffer from outdated housing, unattractive living environments, and obsolete facilities. Due to these reasons and often the lack of new development some new towns even experience a demographic decline (e.g., Capelle a/d IJssel and Westervoort) (Keunen, 2022; CBS Statline, 2022a). Considering their proximity to the adjacent city, it can be useful to understand how these demographics change, so that people want to live there again. This helps with the housing shortages and often a decrease in travel time to the city that provides jobs.

Better-suited facilities also help the current population in accessibility to e.g., education, healthcare, and retail. Different policy recommendations help people living in existing former new towns, but recommendations can also be relevant to new arising large-scale residential VINEX and NOVEX development. For example, the neighbourhood Leidsche Rijn (Figure 1.1) and Ypenburg are both large low-rise residential areas that can be compared to the Dutch new town. These neighbourhoods might develop in the same way and need specific interventions to overcome negative effects.

1.4.2 SCIENTIFIC RELEVANCE

As mentioned in paragraph 1.2 there is an empirical gap in academic literature. Connections between changing household sizes and spatial impacts on the neighbourhood level are not researched, or not extensively enough. There has also been a lack of research on large-scale residential area development and the changes in household composition. It is also scientifically relevant in the context of Dutch research, there is no research on Dutch 'groeikernen' policy and the important impacts that need to be considered in future developments.

1.5 READING GUIDE

Chapter two explores theories related to (Dutch) new towns, including Garden City, Transit-Oriented Development, and New Urbanism. It also examines the functioning of new towns in urban areas, their complexities such as neighbourhood cycles and urban decline, and the impact of demographic changes on facilities. Chapter three explains the research methods used, including regression analyses, photo analysis, and case selection. Chapter four presents findings on Dutch new town policies, population and demographic development, and the influence of demographics on facilities. It also explores the relationship between physical space and demographic changes. Chapter five provides the conclusion, summarizing key findings and insights. Chapter six offers a discussion and interpretation of the research, addressing limitations and areas for further exploration. Chapter seven presents recommendations for policymakers, planners, and stakeholders involved in new town development.

Figure 1.1: Utrecht Leidsche Rijn

Source: Rutting, 2018

2.

THEORETICAL FRAMEWORK

This chapter delves into the theories that underlie the design of Dutch new towns. The concept of 'groeikernen' was introduced in the 1970s and 1980s as a means to create sustainable, liveable, and compact urban environments by utilizing underutilized or underdeveloped land in existing urban areas. The Garden City, New Urbanism, and Transit-oriented development were among the planning approaches that were employed during this period. We will explore these concepts in detail, examining their characteristics and discussing the outcomes of their implementation. In addition to investigating the planning theories that inform the design of new towns, this chapter will also explore the literature on new towns in the context of the broader urban fabric. We will consider how new towns are implemented within the metropolitan region of their adjacent city, highlighting the advantages and complexities associated with this type of development. Furthermore, we will zoom in on the facilities that are present within the new towns themselves. These facilities are critical in achieving the goals of a neighbourhood and are influenced by changes in the population. As such, we will examine how demographics impact these facilities and discuss the implications of these changes for the new towns.

By the end of this chapter, you will have a comprehensive understanding of the theories that underlie the design of Dutch new towns, including the planning approaches that were used, the literature on new towns, and the impact of demographics on the facilities present in these communities.

2.1 PLANNING CONCEPTS BEHIND THE DUTCH NEW TOWNS.

This paragraph explores the various planning approaches utilized by the Dutch government and spatial planners in the development of their new towns. Drawing inspiration from planning concepts that have gained traction worldwide, these new towns incorporate elements of the Garden City, Transit-Oriented Development, and New Urbanism. Besides theories, the Dutch new towns were also inspired by other post-war new town developments in Europe. This paragraph examines the relationship between theories, other European new towns and their implementation in the design of the Dutch new towns.

2.1.1 THE GARDEN CITY

The Garden City is a concept in urban planning that was first proposed by British urban planner Ebenezer Howard (1898). His idea consists of a self-sufficient town surrounded by green belts, with areas designated for agriculture and open spaces. The aim of the Garden City is to combine the benefits of urban and rural living, promoting a healthy and sustainable community (Howard, 1965). It is obvious to seek the roots of thinking about Dutch new towns in the garden city idea of the 1920s. The approach reached the reports of the Western Netherlands Working Committee through the Garden City Commission and later in the first two spatial planning Acts (Faludi & Van der Valk, 1997). The Garden City movement was not necessarily anti-urban but rather aimed to provide an alternative to the overcrowded and unhealthy conditions of large cities at that time (Howard, 1902). It was founded on the idea of combining the benefits of urban and rural living and promoting decentralization, civic life, and a healthy community. Decentralization was seen by the Garden City Commission as an advantage due to the promotion of civic life. The neighbourhood would be much harder to create in a big city than in a small one (PBL, 2012). This pursuit of civic life runs like a thread through the history of modern urbanism, which is closely linked to the pursuit of emancipation, citizenship, and community. The civic life characters from the Garden City movement are something that can be found in the 'groeikernen' policy (PBL, 2012). Whether it is the collective courtyards of the first public housing projects, the neighbourhood idea or the residential yard, the pursuit of community always plays a role (Provoost, 2022). This shows not so much a negative image of the big city, but a positive appreciation of the then-expected rapid growth of suburbanisation. Increased prosperity and mobility would lead to more freedom in choosing where to live. Freedom of choice was also linked to individual development, a concept that has been an integral part of spatial policy ever since (PBL, 2012). However, the garden city idea of Howard (1898) has

2. THEORETICAL FRAMEWORK

been criticised by scholars due to the unfavourable effects of the approach. Some scholars have argued that the development of garden cities reinforces the separation between urban and rural areas rather than promoting the integration of the urban fabric (Moerman, 2020; Fishman, 1991). The idea that the greenbelt preserves open space and prevents the city from sprawling into rural areas can also limit the interaction and integration between these places. The separation of these areas can reinforce social and economic inequalities, as the garden city's middle-class residents may have limited contact with people from different backgrounds or income levels. The distance between the garden city and their adjacent city can reinforce car culture by prioritizing automobile-centric transportation (Jacobs, 1961). This can result in longer commute times and economic strain for residents (Jacobs, 1961). Besides their separation and distance from the adjacent city, there was opposition from environmentalists and conservationists. The garden cities were built on agricultural or open land, bringing concerns about the impact of new residential areas on natural habitats and landscapes (Edwards, 1914).

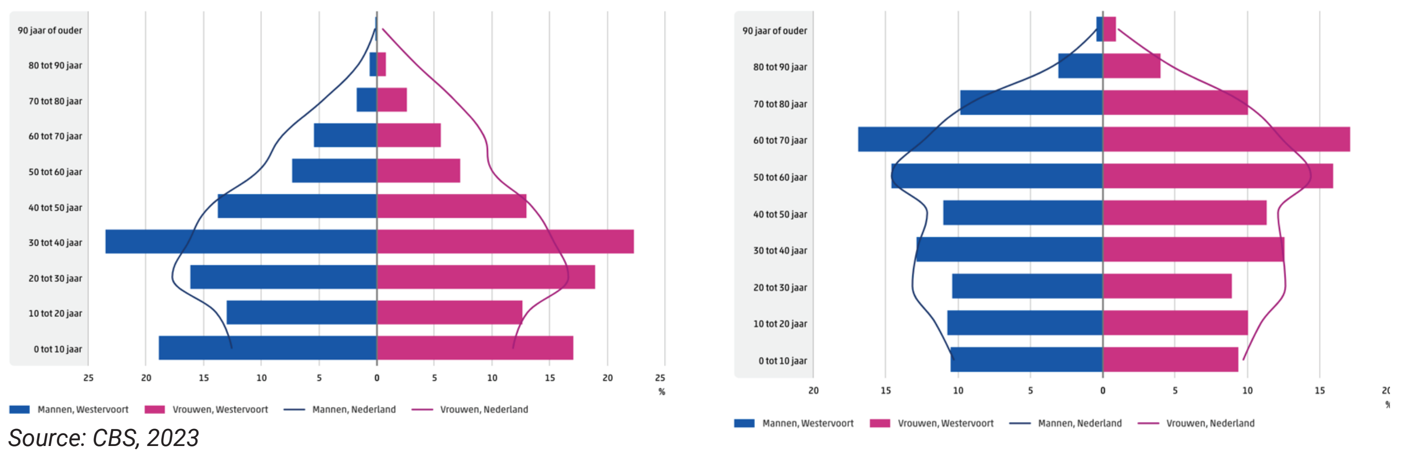
The realisation of new towns regarding the garden city movement, together with the high percentage of single-family homes, led to an influx of young families (CBS, 2023). The relatively high-quality houses compared to the city and suburban lifestyle, a prerequisite for a successful Garden City, resulted in an attractive living environment. The green areas and availability of education made it the perfect place to raise children (Provoost, 2022). The fact that the demographics at that time consisted mainly of young families, has an impact on the new towns to this day. In Figure X the demographics of Westervoort are shown. A new town of Arnhem that suffers from ageing. Back in 1990, Westervoort had far more people in the age group 0-10 and 30-40 compared to the Dutch average. That indicates the presence of families. Around 30 years later in 2022, the largest group consisted of people between 60 and 70 years old (above the Dutch average). Which is exactly the group that was between 30-40 years in 1990. Meanwhile, their children moved away according to the pyramid.

2.1.2 TRANSIT-ORIENTED DEVELOPMENT (TOD)

Where civic life and greenery played a central role in the Garden City approach, Dutch new towns also heavily emphasized good public transport connections. The Transit-Oriented Development (TOD) approach has been applied in the urban design of new towns (Reijndorp et al., 2012). Urban developments in the past and to this day are often framed as transit-oriented developments. TOD is a planning strategy that emphasizes the creation of compact, mixed-use communities centred around high-quality public transportation systems (Hrelja et al., 2020). The objective of TOD is to promote sustainable and efficient urban growth by encouraging people to use public transportation, walking, and biking instead of personal vehicles such as cars (Hrelja et al., 2020).

The principles of TOD are rooted in the concept of smart growth, which emphasizes the need for compact, walkable, and transit-friendly communities (Calthorpe & Fulton, 2001). These pedestrian-friendly neighbourhoods re-

Figure 2.1: Demographic pyramid of Westervoort in 1990 & 2022



Source: CBS, 2023

duce traffic congestion and car dependency by providing residents with convenient access to amenities and workplaces (Vega et al., 2023). Therefore, TOD focuses on developing mixed-use areas that incorporate residential, commercial, office, and civic uses. The design of these areas is centred around high-quality public transportation systems that provide frequent, fast, and reliable service. Besides public transport, active transport is facilitated in transit-oriented developments. Due to this, the average health of people in TOD regions is significantly higher (Lang et al., 2020). But also, health in a broader sense, such as social sustainability. The general quality of life increases in comparison to regular city development that is not focused on active- and public transportation (Lang et al., 2020). Sometimes it is argued that there is a potential that transit-oriented development excludes lower-income residents and its reliance on market forces to drive development (McDougall et al., 2023). While transit-oriented development can increase property values and attract investment, this can also lead to gentrification and displacement of existing residents (Padeiro et al., 2019). This can be avoided by incorporating affordable housing to ensure that all population groups can benefit from transit-oriented development. To overcome that market forces are the only drive behind the development, the developer should advocate for a community-based planning process that prioritizes equity and social justice (Padeiro et al., 2019).

The application of TOD is different in all the Dutch new towns, with some of them having better access to public transportation than others. However, it can be said that in all the Dutch new towns, there is some form of public transport accessibility, and all bicycle infrastructure is good. Good examples of TOD in Dutch new towns include the Zoetermeer Stadslijn as seen in Figure 2.2. This Stadslijn originally functioned as a regional train service towards The Hague and now functions as Randstadrail and changed from train to tram service (Van Vulpen, 2022). The SUNIJ-tram was established in 1983 in Nieuwegein to improve commuting to Utrecht's city centre (Reijndorp et al., 2012). Figure 2.2 presents a visualization of the SUNIJ tram. Unlike Nieuwegein and Zoetermeer, Almere does not possess a tram or light rail network. Instead, the city was designed to accommodate a comprehensive bus network that includes dedicated bus lanes, completely isolated from regular streets (Reijndorp et al., 2012). Every residence in Almere is situated within 400 meters of a bus stop, and all bus lines connect to a train station where people can switch modes. To show that communities are also walkable, all yellow parts in the maps are small or large shopping areas.

2.1.3 NEW URBANISM (NU)

Walkable communities and good accessibility are a big part of TOD. However, New Urbanism provides more qualitative requirements for the built environment. The New Urbanism theory promotes the development of walkable, mixed-use communities that provide a sense of community and encourage social interaction (Grant, 2005). Dutch new towns were built with the New Urbanism theory in mind. The new towns often include the development of new mixed-use spaces and the creation of new public spaces, such as squares and parks, to create liveable and walkable environments (Reijndorp et al., 2012). New Urbanism gained attention due to its potential to enhance public health, support economic development, and make cities more social (Ellis, 2002).

New Urbanism focuses on less urban sprawl, mixed-use neighbourhoods and lively communities (Ellis, 2002). This is in combination with promoting walking and cycling by designing streets and public spaces that prioritize pedestrians and cyclists (Ibrahim et al., 2022). This involves creating safe and comfortable walking and biking environments that encourage active transportation. An example of this is the cycling roundabout in Houten, as seen in Figure 2.3. This bike infrastructure creates separate bike lanes that improve safety and ensure cyclists do not have to wait for cars. New Urbanism is a form of development that results in lively centres that enhance connections among residents, due to more interaction on the streets between pedestrians and neighbours (Langlois et al., 2016). The fact that New Urbanism prioritises people over cars and focuses on community life, results in more social cohesion and overall well-being. New Urbanism can support places that are vibrant

that attract businesses, residents, and visitors. This often leads to job growth, tax revenues and increased property values (Shatu et al., 2022). There is this increase in urban vibrancy created by the agglomeration of opportunities and functions within a city area (Yang et al., 2021). The jobs, services, and amenities in these areas are also better accessible. Especially for low-income households and people without access to a personal vehicle. This can help reduce economic inequality and increase opportunities for social mobility (Shatu et al., 2022). On the other side, some scholars criticized New Urbanism for its potential to reinforce class and racial divisions and for its emphasis on design over policy (Markley, 2018; Grant, 2006; Kenny & Zimmerman, 2004). While it emphasizes walkability and mixed-use development, it can also create exclusive, high-end neighbourhoods that exclude lower-income residents. Equity and inclusivity are something that should be included in its design principles (Merkley, 2018). While New Urbanism has contributed to innovative and sustainable urban design practices, it often does not sufficiently address broader policy issues such as affordable housing, and transportation (Grant, 2006). A more comprehensive approach to urban planning should integrate both design and policy considerations.

Figure 2.2: TOD in different new towns

Source: Google Earth, 2023 (edited)

Figure 2.3: Bicycle roundabout in Houten

Source: Apple Maps, 2023 (edited)

2.1.4 THE COMBINATION OF PLANNING THEORIES IN DUTCH NEW TOWNS

The Dutch Groeikernen policy was influenced by the mentioned urban planning approaches. One of the key influences was the Garden City approach, which emphasized green spaces, self-sufficiency, and community life (MHSP, 1972). Ebenezer Howard's vision was taken up by the Garden City Commission in the Netherlands and was later reflected in the first two spatial planning Acts. Another influence on the Groeikernen policy was New Urbanism (MHSP, 1972). This involved an emphasis on mixed-use development, pedestrian-friendly streets, and the preservation of historic neighbourhoods (Grant, 2005). For example, the integration of the old Vreeswijk in Nieuwegein, or 'Het Oude Station' in Houten, shown in Figure 2.4 & 2.5. Groeikernen were aimed to create walkable, human-scale communities that were socially, economically, and environmentally sustainable (Provoost, 2022). New Urbanism was seen as a response to the sprawling, car-centric development patterns that had dominated American cities since the mid-20th century and was also getting implemented in the Netherlands (Ibrahim et al., 2022; MHSP, 1972). Lastly, there was Transit-Oriented Development as an influence on the Groeikernen policy. TOD emphasizes transit connectivity and compact development, with dense, mixed-use development around transit hubs (Lang et al., 2020), such as in Capelle a/d IJssel (Figure 2.6 & 2.7). It aims to reduce dependence on cars and promote more sustainable, livable communities. TOD gained popularity because it is a way to address urban sprawl and reduce greenhouse gas emissions (Hrelja et al., 2020). Paragraph 2.1.2 explained that all Dutch new towns possess a public transportation system that connects them to the metropolitan region where there are situated.

The synergy between these different approaches can be seen in the design of Dutch new towns. For example, many Dutch new towns feature compact, mixed-use development around transit hubs, pedestrian-friendly streets, and ample green spaces (Reijndorp et al., 2012). These elements reflect the principles of New Urbanism and TOD, while also drawing on the Garden City approach's emphasis on community and self-sufficiency. However, implementing these approaches in practice can be challenging. The emphasis on compact development can sometimes clash with the desire for more space, and the preservation of historic neighbourhoods can sometimes conflict with the need for new housing and infrastructure. Finding a balance between these different approaches was and is an ongoing challenge in the design and development of Dutch new towns.

Figure 2.4 & 2.5: Vreeswijk in Nieuwegein and 'Het Oude Station' in Houten

Source: Own research, 2023; Dijkstra, 2017

2.2 NEW TOWNS WITHIN URBANISATION PROCESSES

Not only the Netherlands built new towns in the past. The increase in the world's population led to significant shifts in the global population from rural areas to metropolitan areas with new towns. Nowadays more than half of the urban population lives in cities and urban regions (Gharaibeh et al., 2023). To manage this rapid urbanisation new living areas need to be developed. The development of new living areas can have different forms. Three internationally used developments that relate to the Dutch 'groeikernen' are satellite cities, new towns, and bedroom communities. The academic literature shows that there is no distinct difference between these three because they get used interchangeably (Chatterjee & Chattopadhyay, 2020). Especially the satellite cities and new towns are often seen as the same thing. The bedroom communities may have some spatial and economic differences and are therefore clarified in their paragraph.

2.2.1 SATELLITE CITIES?

Satellite cities and new towns are most of the time interchangeably used in different research (Chatterjee & Chattopadhyay, 2020). However, one thing that sometimes differs is that satellite cities can grow organically, whereas new towns are always planned from scratch, or negligible small villages get used as a starting point. Because they are often taken together, this paragraph will explain the two concepts in the same way. To the avoidance of confusion, this paragraph uses the term satellite cities. This is because new towns are also a self-standing concept in the UK.

Back in 1915, the satellite city was first mentioned by Graham Romeyn Taylor. His book was called 'satellite cities; a study of industrial suburbs'. The reason for his new spatial planning idea is mentioned in his foreword:

"Congestion, with all that it means in choked streets, dark work rooms and high taxes, has been forcing factories to our city limits and beyond...It endeavours to set forth the opportunity in these outskirts for applying the technique which is being developed and the idealism which is finding expression in the new science of town planning. For while industrial managers have shown extraordinary foresight, skill and ingenuity in the arrangement of their plants in the outlying areas, no such expert planning has gone into the accompanying community development." (Taylor, 1915, p. 4).

He wanted to take advantage of the fact that factories were moving to the outskirts of cities. This gave the opportunity to establish living communities with better living conditions compared with the current city. Besides the fact that industrialisation in Western cities is not happening anymore, satellite cities are still housing a large urban population. The idea of the satellite city and new towns evolved as a visionary concept that found better ways of living compared to the city

Figure 2.6 & 2.7: High density in Capelle a/d IJssel next to a train station/metro station

Source: Apple Maps, 2023

and is still considered a process of evolving urbanism around the world (Chatterjee & Chattopadhyay, 2020).

Satellite cities are urban developments inside the daily-urban system of existing large cities or metropolitan areas, but outside of the current city borders (Shi & Chen, 2016). This satellite city development is a process that involves the creation of a completely new city or whole neighbourhoods from scratch, often in greenfield areas (Lang, 2013). These cities and neighbourhoods include the construction of new residential, commercial, and industrial areas, as well as infrastructure such as roads, bridges, schools, and hospitals (Liu & Song, 2011). Satellite cities do not solely serve as residential areas, as they also must offer job opportunities to promote a balance between work and living arrangements for their inhabitants (Shi & Chen, 2016). This process is typically undertaken by government agencies or private developers to address the needs of a growing population or create new economic opportunities (Gupta & Nath, 2014; Kamruzzaman & Islam, 2015). The goal is to create sustainable communities that provide a high quality of life for residents while supporting local businesses and industries (Hsu, 2013). Furthermore, the development of these cities can also alleviate urban sprawl and congestion in existing cities and provide new opportunities for people to live and work in a more rural or suburban setting (Chang & Li, 2010; Zhang et al., 2012). However, challenges such as securing funding and ensuring the economic viability of the satellite city (Jain & Chaudhary, 2016), as well as balancing the needs of residents with those of local businesses and the environment, can be obstacles to successful development (Wang et al., 2011).

2.2.2 BEDROOM COMMUNITIES

Next to satellite cities, there is another form of urban expansion that is comparable to a new town. These places are often called ‘bedroom communities’. Bedroom communities have emerged as an alternative form of urban living in which residents predominantly reside and commute to adjacent cities for work. Although no universally accepted term exists to describe these towns, ‘bedroom communities’ is the prevailing term in the United States (Jolley et al., 2011), and ‘dormitory towns’ is the preferred naming in the UK (Chatterjee & Chattopadhyay, 2020). Furthermore, some academic literature refers to them as ‘commuter towns’. Despite the different terminology, these urban developments share similar characteristics. Towns that provide housing opportunities for people that work in the cities nearby. They are monofunctional, most often the inexistence of any other urban use except the residential one (Dinić & Mitković, 2016). Bedroom communities are often smaller compared to a satellite city or new town and have fewer job opportunities within their city limits. The few job opportunities that they have, consist of a residential economy, which generates local business activity and accompanying employment (Kaufmann & Wittwer, 2019). Their main difference with regular suburbs is that bedroom communities have their own municipality and are not part of the large adjacent city regarding municipal legislation.

2.2.3 THEIR ADJACENT CITY

Residential developments like the satellite city and bedroom communities are strongly influenced by their adjacent city. These places often rely on their adjacent large city for job opportunities, recreation, shopping, and other amenities (Desponds & Auclair, 2017). The extent of the influence of the large cities on the new towns is such that they are often formed by them (Hillman, 1975). The adjacent city is usually located between 10-20 kilometres away from the satellite city or new town, and they are connected by expressways, access roads, and/or rail transportation (Shi & Chen, 2016). This interdependence between large cities and new towns has significant implications for the latter’s economic growth and job opportunities. Research conducted in Switzerland by Kaufmann and Wittwer (2019) found that small and medium-sized towns (SMSTs) located in dynamic regional networks near large cities exhibit an increase in full-time-equivalent jobs in the export-oriented sector. This suggests that new towns that are well-connected to their adjacent large city can experience growth in employment opportunities. However, some new towns, such as Skärholmen in Stockholm, are designed to provide rapid transit towards the metropolitan city, where residents are expected to work

(Hillman, 1975). Transportation options between the new towns in the same city region are often limited compared to those that connect them to the large adjacent city, which can have a significant impact on job opportunities in the new towns (Desponds & Auclair, 2017). This is evident in towns such as Nieuwegein and Houten, where there is a focus on transportation options to Utrecht rather than between the new towns in the region. Key variables between the adjacent city and new towns include transportation options, highway exits, housing values, and distance towards the large city (Kaufmann & Wittwer, 2019).

2.3 COMPLEXITIES OF NEW TOWNS

Citizens residing near facilities in new towns are actively utilizing them. However, as mentioned before, the demographics of a neighbourhood, such as population size, household structure, and age distribution, are continually changing. These changes also occur in new towns, prompting the question of how exactly they evolve. Theories have emerged that categorize neighbourhoods into distinct “life cycles” or “stages,” each with specific demographic, socioeconomic, and built environment characteristics that define them during a particular period. Besides the cycles a neighbourhood goes through, different complexities arise with an ageing population. This paragraph will elaborate on different theories that talk about life cycles, ageing, and its complexities.

2.3.1 NEIGHBOURHOOD STAGES

The neighbourhood life cycle theory has its starting point in urban planning in the United States. It was used in the 1960s by local planners to analyse and redevelop neighbourhoods (Metzger, 2000). The theory made it possible for planners to understand neighbourhood stages, and to disperse citizens deliberately in the city. At the end of the 20th century, urban planners assumed that neighbourhoods would always go through five stages (Metzger, 2000). Table 2.1 shows that in the 20th century, the urban decline was focused on economics and made links directly related to race, high-density developments, and rental housing. The notion that all neighbourhoods must start with homogeneous housing and consist primarily of moderate to high-income, insured, financially stable, and predominantly white citizens is outdated and not focused on the Dutch environment. It is no longer accurate to equate diversity in ethnicity and income directly with an unhealthy or declining neighbourhood (Bolt et al., 2002). The same for the fact that neighbourhoods with a higher density of housing are in a declining phase. This clashes with the new planning paradigm where urban densification is seen as something desirable (Dehghani, Alidadi & Sharifi, 2022). However, this framework of neighbourhood stages is still useful in another way. Visible deterioration, problems in securing finance, high unemployment, declining public services, and high crime rates, are still signs of a declining neighbourhood (Aiyer et al., 2015). Therefore, this life cycle theory is a starting point for a newer one.

2.3.2 URBAN DECLINE IN NEW TOWNS

Recent research emphasizes the fact that urban decline can be explained by the differing regional spatial and institutional contexts (Hoekveld, 2014). To start with the spatial context, a couple of aspects play a role in the urban decline. First, there is the peripherality of a place. The peripherality of a place is determined on the basis of the distance to the economic and administrative

Table 2.1: Neighbourhood stages according to the U.S. housing and urban development department.

Stage 1: Healthy	Homogeneous housing and moderate to upper income, insurance, and conventional financing available.
Stage 2: Incipient Decline	Ageing housing, decline in income and education level, influx of middle-income minorities, fear of racial transition.
Stage 3: Clearly Declining	Higher density, visible deterioration, decrease in white in-movers, more minority children in schools, mostly rental housing, problems in securing insurance and financing.
Stage 4: Accelerating Decline	Increasing vacancies, predominantly low-income and minority tenants or elderly ethnics, high unemployment, fear of crime, no insurance or institutional financing available, declining public services, absentee-owned properties.
Stage 5: Abandoned	Severe dilapidation, poverty and squatters, high crime and arson, negative cash flow from buildings.

Source: Metzger, 2000

core area of a country or region (De Renzis, Faggian & Urso, 2022). In the Netherlands, these are situated at the edge of the country. Examples are South Limburg, North Groningen, and parts of Zeeland (Hoekveld, 2014). The new towns addressed in this research are mostly situated in the economic core area of the Netherlands, the Randstad. Except for Helmond and Duiven-Westervoort, they function as suburbs of Eindhoven and Arnhem.

Another characteristic that can result in urban decline is linked to the fertility rate. In some urban regions, the fertility rate is decreasing. This decrease is in a lot of countries in Western Europe so strong that the natural population development is negative (Bergsvik, Fauske & Hart, 2021). This low fertility rate results in an ageing population where household structures change (Hoekveld, 2014). The declining fertility rate is also evident in certain Dutch new towns, such as Purmerend, where there were 803 deaths and only 761 births in 2020. The natural population growth rate would have been negative in 2020, if not for the influx of migrants to the municipality (CBS Statline, 2023c). The population in the Netherlands is still growing unless a low fertility rate. This is all due to immigration from other countries (CBS Statline, 2022a). Immigration can therefore be a solution to an ageing population and population decline. However, it is found that cities that only attract domestic migrants vary a lot over time. Whereas cities that attract international immigrants are often more stable over time (Frey & Liaw, 1998). This is especially in the United States the case but has also been found in the Western European context (Hoekveld, 2014). This is interesting because suburbs are often the destination for young couples from the core city. This means that the migration is mostly domestic.

Besides all the demographic factors, a lot of literature is very hard to generalise to different spatial environments. This has to do with the institutional context in where the neighbourhoods or cities are placed. Policies can aggregate, alleviate, or avert the effects of certain wider societal forces (Kazepov, 2008). This means that societal changes in a city region due to e.g., migration patterns, are also heavily impacted by the given policies in that area.

Another relevant example is how governments do spatial planning. The degree of privatization of governmental planning activities influences the ability to determine how planning is done in the city or country (Hoekveld, 2014).

2.3.3 AGEING IN PLACE

The stages in Dutch new towns and the greying population are influenced by the so-called ageing in place. Ageing in place has become an increasingly popular concept for older adults who want to remain living in their homes and communities for as long as possible. Partly, because of the post-retirement population that has increasingly become more urban (Milton et al., 2019). And partly from the national policy of the Dutch Ministry of Public Health, Welfare, and Sport (2018) that promotes ageing in your own house. Ageing in place is defined as "the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level" (CDC, 2021). The concept of ageing in place is rooted in the environmental gerontology perspective, which emphasizes the importance of the physical and social environment in promoting health and well-being in later life (Ma et al., 2022). The physical environment plays a crucial role in ageing in place, as it can either facilitate or hinder older adults' ability to remain in their homes and communities (Kan et al., 2020).

Figure 2.8: Scootmobile at front porch in Purmerend

Source: Own research, 2023

When a population ages, health needs change and the design and the requirements of an urban space also need to change (Milton et al., 2019). The new towns built as a response to population growth and urbanization have aged in the last decades. Challenges arose due to demographic change and ageing in these communities (Reijndorp et al., 2012). Specifically for the Dutch new towns it has been observed that children often move away while their parents stay, leading to changing demographics and a need for different facilities in these communities (CBS, 2023). The ageing of new towns presents an opportunity to explore how the physical and social environment can be adapted to support older adults' needs and preferences.

The Dutch new towns serve as a specific case study of the link between ageing in place and the ageing of new towns in the Netherlands. The communities were designed to create a sustainable and attractive living environment for a diverse population (Provoost, 2022). As the population of the Dutch new towns has aged, new challenges have arisen, such as the need to adapt the built environment to support an older population. To address these challenges, new towns can implement several initiatives to support older adults' ability to age in place. For example, developing a network of care and support services, such as home care, transportation, and social activities, to meet the needs of older adults (Buffel et al., 2012). The municipality can also modify the built environment by installing accessibility features like ramps and elevators in public spaces and buildings, street furniture, and community centres (Milton et al., 2020; Tinker & Ginn, 2015). Importantly, challenges still need to be addressed in the Dutch new towns as the population continues to age (CBS, 2023). For example, there is a need to develop more affordable housing options for older adults and to address social isolation and loneliness (Buffel et al., 2012). The changing demographics of new towns present an opportunity to develop more age-friendly communities that support the needs and preferences of older adults, and the experience of the Groeikern can serve as a useful model for other towns and neighbourhoods facing similar challenges.

2.3.4 COMPLICATIONS IN NEW TOWN REALISATION

One potentially positive aspect of the development of new towns is generating additional housing units, providing a mix of units in terms of size and tenure, and having lower investment requirements than other options (Bowie, 2017). However, there are also potential negative aspects to consider. First, the planning of a new town is often very time-consuming and long-term development (Shi & Chen, 2016). Besides that, other negative aspects include the costs of subsidizing employment relocation or growth, and increased population in low-density areas that may generate the need for additional social and transport infrastructure. There are sometimes long travel times and high travel costs for commuters to employment centres if local employment provision is insufficient or inappropriate (Bowie, 2017). This is especially the case when dealing with a bedroom community. There is also the potential dispersal of households to areas where the potential for employment is low with an increased concentration of the most vulnerable, economically non-safe-sufficient households (Bowie, 2017). Problems with concentrating population groups can also be the other way around, such as social and economic enclaves, where they constitute sites of spatial exclusion that privilege certain types of economic activities and middle-class demands (Van Leynseele & Bontje, 2019). It is important to carefully weigh these factors when considering building satellite cities, new towns, or bedroom communities.

2.4 NEW TOWNS AND THEIR FACILITIES

Over the past two decades, the new towns in the Netherlands have aged. Investments have been made in facilities and commercial centres in nearly every Dutch new town. The outdated styles from the 70s and 80s have been replaced to modernize the architecture (Provoost, 2022). Dated theatres, libraries, and other facilities have either been updated or replaced altogether. However, despite these efforts, the citizens of these now middle-sized Dutch cities still feel as though they are incomplete cities, due to a backlog of social-cultural, and often commercial facilities since their inception (Provoost, 2022). When compared to other cities of similar size in the Netherlands, the new towns consistently fall short in this regard. Interestingly, this lack of progress occurred despite having the most progressive cabinet in Dutch history at the time. Overall, this paragraph explores the development of different forms of facilities in the 70s and 80s and how they function in the Netherlands, but also in other new towns around the world.

2.4.1 RETAIL AND RECREATIONAL FACILITIES

The principle of self-contained and balanced communities was guiding in the early new towns. People living in new towns were supposed to have enough retail opportunities within their own city borders. Dutch new towns often had their own newly built shopping mall or city centre (Provoost, 2022). This was also the planning principle in other new towns outside of the Netherlands. However, in the UK it was found by Dawson & Kirby (1977) that people still travelled outside of their communities. In the UK this led to the abandonment of this principle in later waves of new town development. At this day new towns are often viewed as part of a larger regional or metropolitan planning complex. Besides the fact that they are closely placed towards the adjacent larger city, there are often high quality and fast transportation options that make it appealing to shop in the larger city. To this day it is still popular to travel to the larger city to shop for different kinds of goods (Demazière, 2022). However, when buying necessities such as groceries, proximity to retail plays the biggest role in shop choice (Amrit, 2021). At this day supermarkets compete more with online grocery shopping, and a younger population can enhance this effect (Tyrväinen & Karjaluoto, 2022). This effect is not researched yet in a new town area.

Leisure and recreational planning in new towns has historically been casual, with little integral or organized planning beyond basic public facilities such as parks, public libraries, and large sports facilities (Waldorf, 1966). However, Dutch new town development has expanded to include private and commercial facilities such as cafés, cinemas, and bowling alleys (Provoost, 2022). Gathering substantial information about user needs and preferences is necessary to determine what amenities the community needs or values. In the UK, demographic data is often used to estimate user demand and determine the amount of open space needed per person in new town development (Waldorf, 1966). In the global context, there are different findings considering recreational facilities. In Asian new towns, it often shows that there is a lack of recreational opportunities e.g., Tin Shui Wai and Tung Chung near Hong Kong (Chan, 2012; Goudsmit, 2021). Unlike in Asia, the French new towns had recreational spaces planned between them e.g., Cergy-Pontoise Park (Rey, 2022). In the United States, Sijuwade (2020) found that recreational facilities are relatively good in new towns compared to regular places that often consist of urban sprawl without any facilities at all.

In Dutch new town development, recreational facilities such as libraries and community centres are often combined into multifunctional neighbourhood centres to facilitate greater interaction between different groups in society (Provoost, 2022). The idea behind this approach is to create an environment that allows for more diverse social interaction and cultural exchange. Many Dutch new towns implemented this approach with centres such as Wijkcentrum Meerzicht in Zoetermeer, De Stoep in Spijkenisse, and De Terp in Capelle a/d IJssel.

2.4.2 HEALTHCARE FACILITIES

In addition to the focus on recreational facilities, many new towns also had a progressive attitude towards healthcare planning. In some cases, experiments were conducted to organize healthcare in new and innovative ways, leading to the development of entirely new healthcare systems (Bruijnzeels et al., 2013). New towns provide a unique opportunity to study and learn from the healthcare systems that have been developed in different regions around the world (Bruijnzeels et al., 2013). The Dutch government also had innovative ideas for healthcare facilities, including a new generation of hospitals that were integrated into the city instead of isolated on the outskirts. In Nieuwegein, Purmerend, Capelle a/d IJssel, and Almere, a new type of hospital known as the "passage" hospital, were built (Provoost, 2022). These hospitals were designed with a central street that provided space for living, shopping, and socializing, with the aim of making the hospitals more adaptable and long-lasting. Considering the changing demographics in Dutch new towns, the impact of demographics on healthcare facilities is a crucial aspect to consider in healthcare planning and policymaking. Research has revealed compelling findings that illustrate the effect of population dynamics on healthcare systems. Kis et al. (2017) discovered that as a community ages, the need for healthcare facilities increases, indicating that demographic changes can influence healthcare demand. Similarly, Yeganeh (2019) reported that ageing populations will exert more pressure on healthcare systems, highlighting the importance of addressing this issue. Demographic changes can have significant implications for health services planning and policies, particularly in cases where rapid declines in demographic rates occur (Salam, 2019). This of course also happened in the Dutch new towns, and to a lesser extent in the Netherlands as well.

2.4.3 EDUCATIONAL FACILITIES

New Towns provide opportunities to develop educational facilities through external and internal organizational processes. For example, in the United Kingdom, the planning of New Towns included the design of educational facilities by a larger organization (Abdi-Daneshpour, 1983). The programming of housing development and population are closely related to educational facilities, especially in New Towns where a substantial number of houses are built, requiring coordination between education and housing (Abdi-Daneshpour, 1983). Population measurement and forecasting are crucial in education and New Town planning. Population forecasts are most extensively used in education planning, and in New Towns, they provide the basis for determining land use requirements and specific demands for housing stock, employment, and school provision (Abdi-Daneshpour, 1983). Four components of population structure affect the nature and extent of school places in education, including the actual rate of population increase, the demographic structure of the population, household size, and household composition (Abdi-Daneshpour, 1983).

New forms of education

The political circumstances in the period between 1970-1980 heavily influenced the view on education (Reijndorp et al., 2012). At the same time, new towns provided opportunities for innovation in education because they were built from scratch. This led to the introduction of new secondary educational levels, MAVO, HAVO, and VWO, and the improvement of secondary education accessibility and student flow (Provoost, 2022). In the beginning years, new towns did not have enough citizens to support fully functional schools, resulting in the construction of modular buildings to support the growing population (Provoost, 2022). Modular schools were also designed to reduce social contradictions by mixing all types of education in one building. This mixing idea also took hold in preschools and primary schools, which were combined. Many new educational forms emerged in new towns during this time, such as the Jenaplanschool, Montessori, and Vrije School (Waldorf School) (Provoost, 2022). The new views on education were also happing in new towns in the United States (Hardy, 1991).

Figure 2.9: Wijkcentrum Meerzicht in Zoetermeer

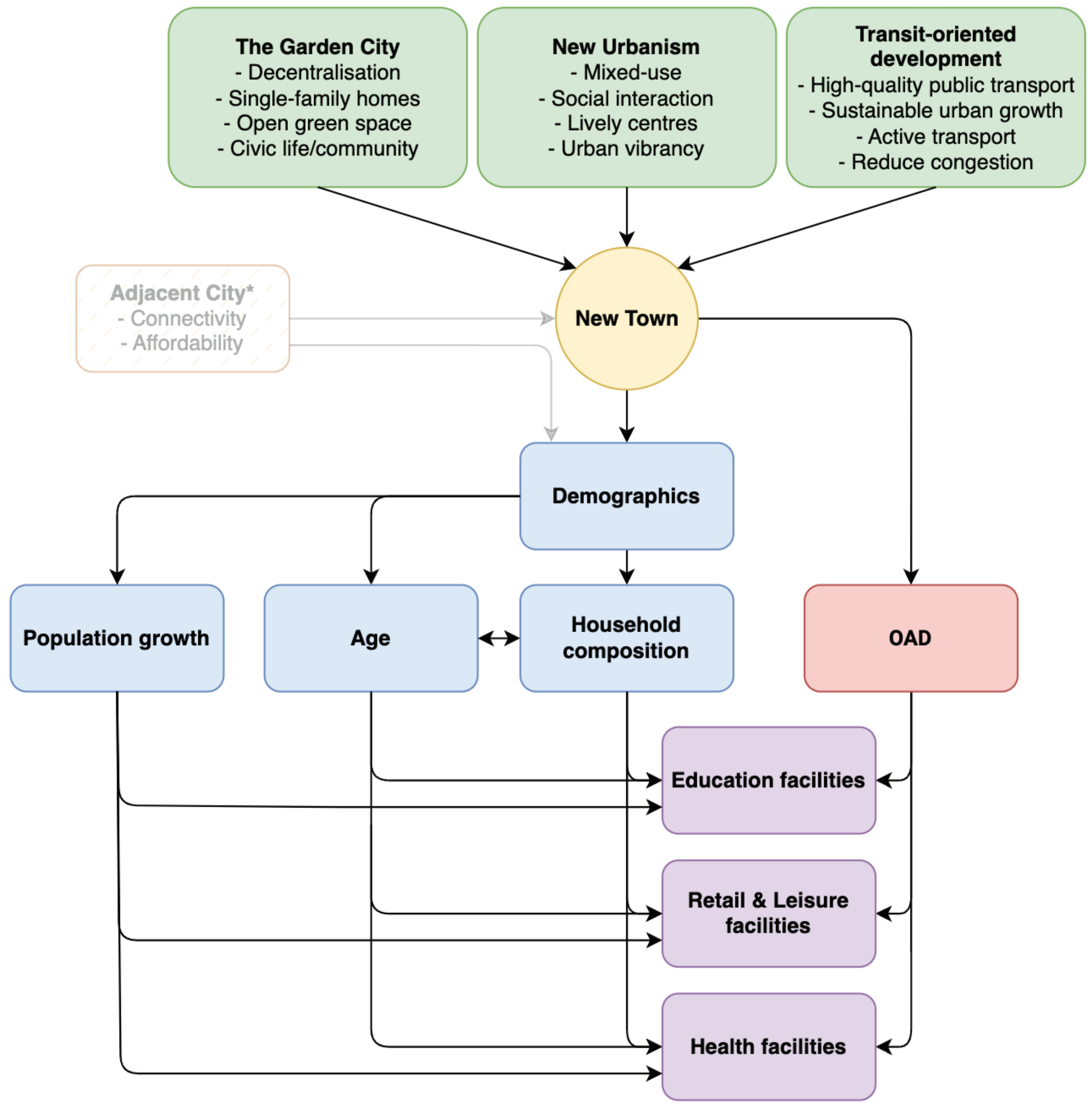
Source: Stadsarchief Zoetermeer, 1980

2.5 CONCEPTUAL MODEL

Having explored various theories and concepts in the theoretical framework, including the Garden City, New Urbanism, TOD, and the adjacent city, it is now crucial to develop a cohesive conceptual model that integrates these elements into a unified framework. The green part of the conceptual model shows these various theories and concepts. They are of direct influence on how the Dutch new towns were designed and influenced. The Garden City emphasizes decentralization in its approach and was the main idea behind the decentralization of the Dutch urban fabric (Faludi & Van der Valk, 1997). It also led to the development of single-family homes, open green spaces, and the focus on civic life and communities (Howard, 1902; Howard, 1965, Provoost, 2022). The New Urbanism approach was supposed to lead to a more mixed-use premise in the urban design of the new towns (Grant, 2005). The reality shows that this is often not the case (Provoost, 2020). Furthermore, New Urbanism stands for more lively centres, with more social interaction and urban vibrancy in the town (Ellis, 2002; Langlois et al., 2016; Shatu et al., 2022). Then the TOD relates to the focus on high-quality public transport and active transport on the premise that congestion would decrease (Vega et al., 2023; Lang et al., 2020). It also promotes a sustainable way of urban growth with decreasing carbon emissions, and healthier citizens (Hrelja, 2020; Lang et al., 2020). Lastly, there is an influence on the new town from the adjacent city. For example, connectivity plays a role (e.g., highway access, rail transit) in the design and demographics of a new town (Shi & Chen, 2016). The same with housing prices, new towns are often more affordable to live in and attract other demographic groups, often younger families in the Dutch new towns (Kaufmann & Wittwer, 2019; CBS, 2023). While it is acknowledged that the adjacent city may have an impact on demographics and facilities, this research focuses primarily on the demographic influence of facilities at the neighbourhood or city level. The direct influence of the adjacent city falls outside the scope of this study.

The conceptual model presented in this section aims to synthesize the theoretical underpinnings of the study and establish a framework for examining the relationships between specific demographic variables. The blue section of the model identifies key independent variables, which will be analyzed using multiple regression analysis to explore their interdependencies and provide testable hypotheses. The purple section represents the dependent variables that will be investigated in relation to the independent variables. Additionally, the red variable, representing the degree of urbanization (OAD), is included as a control variable to account for its impact. By incorporating the control variable, we can ensure that the influence of urbanization is controlled for in the analysis. The educational facilities comprise primary schools, secondary schools, and childcare centres. The retail and leisure facilities encompass cafés, cafeterias, and everyday food & drug stores. Lastly, the health facilities encompass general practices. The demographic factors; population growth, age distribution, and household composition, are related to the facilities in new towns.

Figure 2.9: Conceptual model



*The direct influence of the adjacent city falls outside the scope of this study.

3.

METHODOLOGY

Within this methodology chapter, a comprehensive research design is introduced. It integrates three key components: policy analysis, quantitative data analysis, and qualitative photo analysis. This multifaceted approach enables a nuanced exploration of the research topic, ensuring an integrated understanding of the changing demographics in Dutch new towns. By adopting diverse methodological approaches, this chapter delineates the collection, analysis, and interpretation of data, ensuring the research is conducted with rigour and reliability.

3.1 RESEARCH DESIGN

This research adopts a mixed-methods approach, combining quantitative and qualitative research elements to address complex questions (Heyvaert et al., 2013). A mixed-method approach allows for a comprehensive examination of perspectives, interests, and values, leading to more holistic results (Rapanta & Felton, 2019). The quantitative part consists of multiple regression analyses on demographic data and facilities in Dutch new towns. These results are analysed and compared with the same analyses on all the other places in the Netherlands. Given the disparities observed in demographic changes between the Netherlands and new towns, there arises an intriguing opportunity for comparison. This allows us to discern whether specific effects are exclusive to new towns or merely represent prevailing trends across the Netherlands. The qualitative part consists of a policy analysis of documents of the Dutch government in the period between 1960 and 1990. Second, there will be a photo analysis of four different Dutch new towns. A comparative case study facilitates the exploration of similarities and differences among cases for a deeper understanding (Yin, 2018; Cousin, 2006). Conducting multi-case studies enhances the robustness of the research by providing ample data to support the results (Yin, 2018). This mixed-methods approach is well-suited to achieving the research objective, which examines demographic changes in new towns and explores their impact on the built environment through regression and photo analyses.

3.2 DATA COLLECTION AND ANALYSIS

3.2.1 POLICY ANALYSIS

The first part of the data collection consisted of the analysis of policy documents from the Dutch government. They encompass different "Spatial memorandums", other urbanisation plans or just simple notes and summaries from politicians in the period between 1960 and 1980. This analysis resulted in a better understanding of the governmental perspective and planning decisions regarding the development of Dutch new towns. Because the documents and notes are from more than 50 years ago, they are not accessible from the internet. Therefore, this analysis took place in the Dutch National Archive in The Hague. Adding the policy analysis in this thesis result in a more comprehensive understanding of the context and development of Dutch new towns.

3.2.2 MULTIPLE REGRESSION ANALYSIS

Regressions are the most popular and commonly used statistical methods for analysing empirical problems in many different application areas (Fahrmeir et al., 2013). Regression analysis can be used to determine and describe the relationship between two or more different variables (Vänmann, 2009). There exist a large variety of models in regression analyses, however, this research is limited to multiple linear regression analysis.

For the regression analysis, different data sources are used that are provided by CBS Statline. They provide datasets on demographics, facilities, and address densities (OAD) for every postal code in the Netherlands for different time periods. The literature has identified that the adjacent city can also have some influence on the facilities. However, this aspect falls outside the scope of this research, while it mainly focuses on facilities that are influenced on neighbourhood or city level through demographic changes.

Multiple linear regression makes it possible to analyse the relationship between a dependent variable and multiple independent variables. In this research, the dependent variable consists of educational, retail and leisure, or health facilities. These dependent variables show how

the demographics and supply of these facilities are related. The total sample size of postal codes that are analysed is 4.065 cases. These are all the postal codes that are present in the Netherlands. The dataset is based on the PC4; which means that the data is obtained per postal code with the complete number. This makes the dataset more detailed compared to the PC3 dataset, that only uses the first 3 numbers of the postal codes. The dataset has been separated into 1 and 0, with all the cases coded 1 being postal codes in Dutch new towns (n=167). All the cases coded 0 are the remaining postal codes in the Netherlands (n=3878). All the cases that were coded as 1 are cleaned so that the irrelevant outlying areas and non-new town areas have been filtered out. The sample size is always larger than the number of used independent variables. A larger sample size improves accuracy, reduces the chance of random findings, and enhances generalizability (Cohen, 1992; Kline, 2016; Hair et al., 2014).

According to Field (2013) the quality of the data and the appropriateness of the statistical model are crucial factors that can affect the validity and reliability of the results. This regression model uses the following model: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_p X_p + \varepsilon$
In the equation, Y represents the dependent variable being explained. $X_1, X_2, X_3, ..., X_p$ are the independent variables believed to influence Y. $\beta_1, \beta_2, \beta_3, ..., \beta_p$ are the coefficients associated with each independent variable, representing the effect of each X on Y. Before running the regression analysis, the assumptions of linearity, normality, independence, and homoscedasticity are met (Crossman, 2014). In total fourteen different regression analyses were done. They consist of seven different kinds of facilities, both analysed for new towns, as well as the Netherlands.

3.2.3 VARIABLE TABLE

The conceptual and theoretical frameworks guide the selection of variables for each regression. Educational facilities, including primary schools, secondary/high schools, and daycares (regression 1 till 6), are analyzed using the variables HHgrootte, 015jaar, 65jaar, Bevolkingsontwikkeling, HHmetKind, and OAD (Abdi-Daneshpour, 1983). Health facilities (regression 7 till 8) are influenced by age-related and household changes, and therefore analysed with the variables HHgrootte, 015jaar, 65jaar, Bevolkingsontwikkeling, and OAD (Kis et al., 2017; Yeganeh, 2019; Salam, 2019). Retail facilities are impacted by factors like younger populations, demographic declines, and transportation options. These facilities (regression 9 till 14) were therefore analysed with OAD, HHgrootte, 1525jaar, Bevolkingsontwikkeling, and treinstation (Tyrväinen & Karjaluoto, 2022; Waldorf, 1966; Demazière, 2022). An overview of all variables used in the linear multiple regression analyses is shown in Table 3.1 and 3.2. Definition, scale, and variable type are provided.

3.2.4 FIELDWORK

To answer the second sub-question of the research, qualitative data is collected through photos taken in the field and observation. These photos are analyzed to visually represent the impact of changes in household composition on the spatial aspects of the neighbourhoods. To analyze the physical environment, the neighbourhood audit tools suitable for ageing in place are used, as determined by Kan et al.'s (2020) previous research. The audit tools focus on five domains that are suitable for photo analysis: accessibility of pedestrian walkways, opportunities for outdoor respite, urban form, land uses and destinations (facilities), and traffic safety. By using these audit tools, the spatial impact of changes in household com-

Table 3.1: Variable table with the independent variables*

Variable	Definition	Scale	Type
OAD	The density of addresses per square kilometre. It is the way the Dutch statistics measure the degree of urbanism of certain places	Number/km^2	Ratio
HHgrootte	The average number of people that live in a household	Number	Discrete
015jaar	The number of people that are aged between 0 and 15 years old	Number	Ratio
1525jaar	The number of people that are aged between 15 and 25 years old		Ratio
65jaar	The number of people that are aged 65 years or older	Number	Ratio
Bevolkings-ontwikkeling	The average change in population size in the last 5 years. Is negative when population decreased	Growth in numbers	Continuous
HHmetKind	The percentage of households that include children	Percentage	Ratio
Treinstation	The distance towards the nearest train station	Kilometers	Ratio

* The deployed variables differ per regression model

Table 3.2: Variable table with the dependent variables

Variable	Definition
AANT_BASISONDW3KM	Number of primary schools within 3km
AANT_VOORTGONDW3KM	Number of secondary/high schools within 3km
AANT_KDV1KM	Number of childcare centres within 1km
AANT_DAGLEV1KM	Number of shops that fulfill daily needs within 1km
AANT_CAFE1KM	Number of cafés within 1km
AANT_CAFETARIA1KM	Number of cafetarias within 1km
AANT_HUISARTS3KM	Number of general practices within 3km

position on the physical environment can be better understood. The photos also enhance the interpretability and results of the regression analyses. Table 3.4 provides an overview of the characteristics that are used per domain.

3.3 HYPOTHESES

In alignment with the theoretical framework and conceptual model, hypotheses are formulated to be tested in the regression analysis. The literature review saw potential in relation. According to the conceptual model, the independent variables influence three categories of facilities.

The education facilities under examination include elementary schools, secondary schools, and childcare centres. For these dependent variables, the following expectations are anticipated:

H_1: The variables of household size, the number of people between 0 and 15 and 65 years or older, population development, households with children, and address density have a significant effect on the number of (elementary schools/secondary schools/childcare centres) in a postal code.

Three distinct dependent variables are considered for the analysis of retail and leisure facilities: everyday food & drug stores, cafés, and cafeterias. Based on the existing literature, it is noted that these variables are influenced by slightly varying demographic factors compared to education facilities. Accordingly, the following expectations are hypothesized for these regression models:

H_1: The variables of household size, the number of people between 15 and 25 years old, population development, treinstation, and address density have a significant effect on the number of (supermarkets/cafés/cafeterias) in a postal code.

Lastly, the analysis of healthcare facilities, therefore the dependent variable general practices is used. Following the literature, the variables: household size, the number of people between 0 and 15 and 65 years or older, population development, and address density. This gives the following hypothesis:

H_1: The variables of household size, the number of people between 0 and 15 and 65 years or older, population development and address density have a significant effect on the number of general practices in a postal code.

3.4 CASE SELECTION

The case selection process for postal codes is summarized in Table 3.3. Postal codes corresponding to municipalities identified as new towns were collected and then filtered to include only the areas that are truly built up. This step involved removing portions of municipalities that are not built up or comprise small towns not considered part of the new town.

The selection of the four case studies for qualitative photo analysis is based on population development and household size. These two criteria are according to the literature relevant for all facilities and impact the built environment (Salam, 2019; Tyrväinen & Karjaluoto, 2022; Abdi-Daneshpour, 1983). Figure 3.1 illustrates four cases that were selected using this plot. These are the 4 cases that fit these criteria best. Towns with (+) behind their name means that the government gave them an extra growth task around 1985 (Reijndorp et al., 2012).

Table 3.3: Researched postal codes categorized per new town

Municipality	Postal codes
Huizen	1271 - 1277
Almere	1300 - 1363
Purmerend	1440 - 1448
Hoorn	1621 - 1628
Alkmaar	1800 - 1827
Haarlemmermeer	2130 - 2135 + 2150 - 2153
Zoetermeer	2700 - 2729
Capelle a/d IJssel	2900 - 2909
Spijkenisse	3200 - 3208
Hellevoetsluis	3221 - 3225
Nieuwegein	3430 - 3439
Houten	3991 - 3995
Helmond	5701 - 5709
Duiven-Westervoort	6920 - 6922 + 6930 - 6932
Lelystad	8200 - 8217 + 8222 + 8223 + 8225 + 8226 + 8231 + 8232 + 8239 - 8245

constructs or phenomena under investigation (Roberts & Priest, 2006). Regardless of the robustness of the research design or the sophistication of the statistical analyses, the results lose meaning if they do not align with the researcher's intended measurements. In the context of quantitative data, one approach to bolster validity is to examine the variance inflation factor (VIF). This factor serves as an indicator of multicollinearity among the independent variables (de Vocht, 2019). A VIF value exceeding 10 generally suggests a high correlation and necessitates attention. All multiple regression analyses underwent scrutiny to identify VIF values surpassing this threshold, thus ensuring the reliability and validity of the regression models.

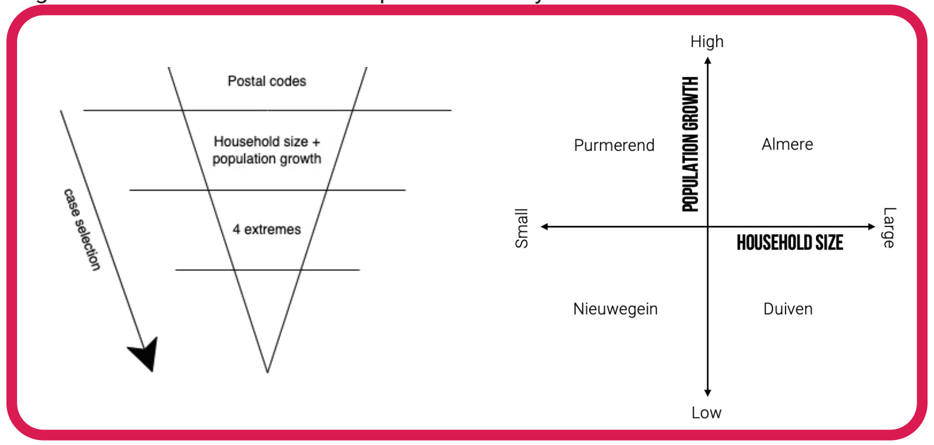
Additionally, reliability holds significant importance in multiple regression analysis. Reliability pertains to the consistency, stability, and repeatability of the estimated coefficients and their significance levels across various instances or settings (Roberts & Priest, 2006). Evaluating the reliability of multiple regression analysis encompasses various key considerations. Firstly, it is crucial to assess whether the model meets the assumptions of linear multiple regression, as discussed in paragraph 3.2.2. In this study, all variables and analyses adhered to these assumptions. Furthermore, data collection also plays a role in guaranteeing research reliability (Gallagher, 2009). The data utilized in this study was obtained from the Dutch government, enhancing the plausibility of its accuracy and integrity. Additionally, outliers and missing data were thoughtfully handled during the analyses. Cases with missing data or standardized residuals exceeding three were removed from the regression model, ensuring the reliability of the results.

Table 3.4: Neighbourhood audit tools, ageing population

Accessibility of walkways	Outdoor respite	Urban form	Land use and destinations	Traffic safety
Sidewalk condition	Rest spots	General maintenance	Parks/open space	Road width
Barriers/hazards	Street furniture	Building types	Community spaces	Pedestrian crossings
Steepness	Street trees		Health services	Buffer zone
Curb cuts			Social services	Textured curb cuts
Accessible transit stops			Outdated playground	
Presence of stairs			Abandoned school	

Source: Kan et al., 2020 (edited)

Figure 3.1: Case selection for the qualitative study



Purmerend (-)	small hh size - high population growth
Almere (+)	large hh size - high population growth
Nieuwegein (-)	small hh size - low population growth
Duiven (+)	large hh size - low population growth

4.

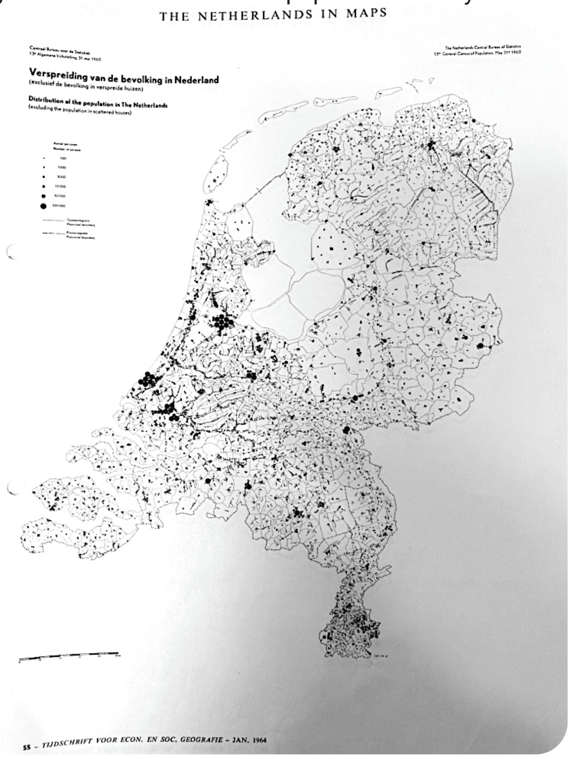
RESULTS

This chapter presents the findings that are obtained through the quantitative and qualitative research that has been done for this thesis. The chapter starts with policy analysis and how the Dutch new towns emerged in the urban fabric of the Netherlands. After that, there are descriptive statistics on how demographics have changed in the Dutch new towns. The data is then used for multiple regression analysis to understand the relation between these changing demographics and in what way they are significant in changing the facilities in the Dutch new towns. The photo analysis obtained in Purmerend, Duiven, Almere, and Nieuwegein provides context, clarifies, or refutes findings for the regression analysis. The resume at the end of this chapter brings all findings together.

4.1 HISTORY AND POLICY CONTEXT OF THE 'GROEIKERNEN'

The 'groeikernen' emerged in a timeframe of around twenty years that started in the 1960s. In May 1960 the Journal of Economic and Human Geography published a map of the population distribution in the Netherlands. This map can be found in Figure 4.1. This map shows that the population in the Netherlands at that time was heavily concentrated in the West of the country.

Figure 4.1: Distribution of the population in May 1960



Source: CBS, 1960

4.1.1 INCREASING POPULATION

In 1965, the Dutch Ministry of Housing and Spatial Planning (MHSP) anticipated a huge population increase until 2000. The expected population in 2000 was 20 million people in The Netherlands. Together with the average dwelling occupation of 3,2, it resulted in more than 3 million new houses that needed to be built. The Ministry (1965) proposed 12 principles for sought-after urbanization. The most important were the deconcentrated urbanisation patterns, clearly discernable urban borders, a clear hierarchy between villages, connecting to the existing facilities, and high-quality public transportation. In May 1965 preparations were being made for the Second Planning Memorandum in 1966. An important factor that heavily impacted future spatial planning was the growing economy. It was assumed that in the year 2000 working-class people were able to spend the same as the middle class did at that time (MHSP, 1965). This had three major consequences. First, the continuation of motorisation to a saturation point where every family would own one car and the wealthier families would have at least two cars. Second, an increase in leisure time, either by shortening the working day and week or extending the holidays. Lastly, a sharp rise in needs, both economic and socio-cultural.

In June of 1966, the Second Planning Memorandum was released, outlining revised expectations for urbanisation processes in the Netherlands (MHSP, 1966). The population increase was estimated to be large. Amsterdam and Rotterdam were both guessed to have more than 1 million inhabitants in 2000, and the Netherlands would have 16 other agglomerations of 250.000 citizens or more. The expected population growth resulted in building plans that were to build 110.000 homes a year in new residential areas. It was supposed to be like an ordered localisation of new towns in the immediate sphere of influence of existing urban areas. Different European (sub) urbanisation plans would be used as inspiration such as the English New Towns and La Cite-Jardin Verticale in Marseille. Also, more general ideas were used as inspiration such as the Garden City approach from E. Howard, and The City in History from L. Mumford (MHSP, 1966).

4.1.2 BUNDLED DECONCENTRATION

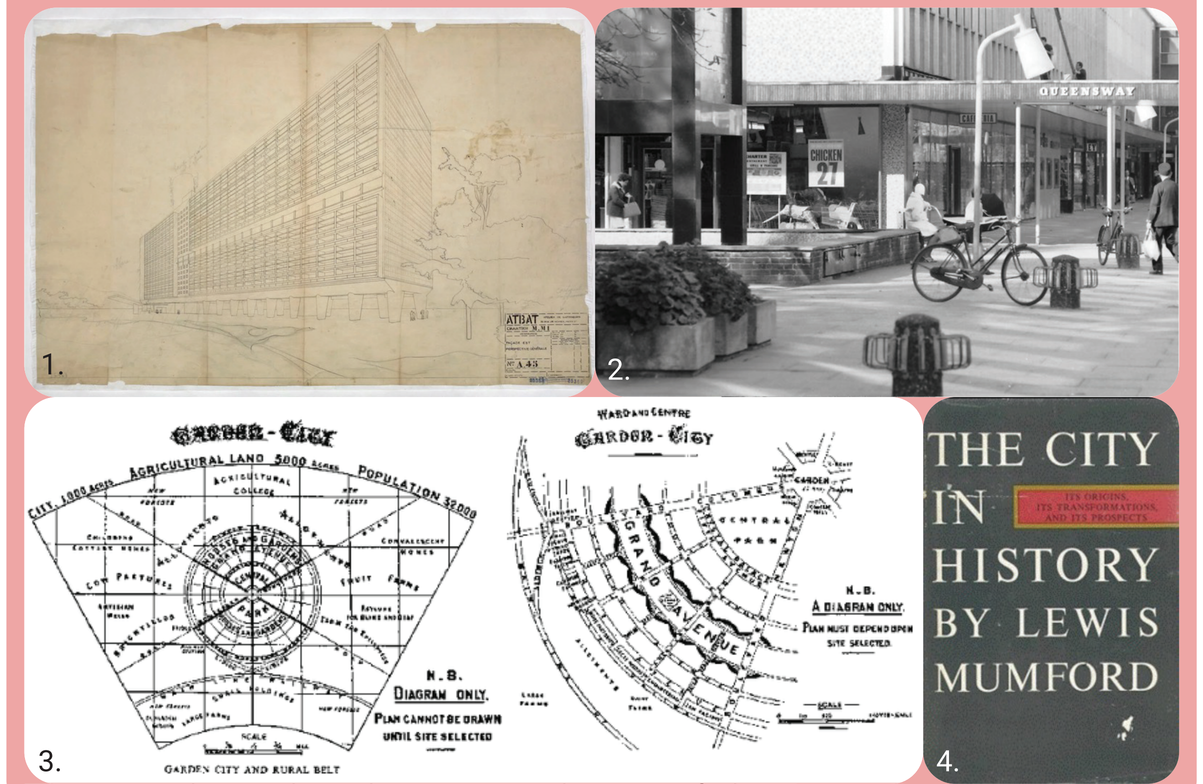
Two years after the introduction of the Second Spatial Planning Memorandum the Ministers made some important decisions. There should be a better distribution of the Dutch population. This should result in less concentration in the West and Southern parts of the Netherlands (MHSP, 1967). Urban planning (blueprint) and the creation of green spaces are two other pertinent concepts that were later applied to the development of 'Groeikernen'. First, a wide range of housing options, predominantly single-family homes, should be available in urban areas. Second, there needs to be an open green space between the metropolitan centres in the Western Netherlands, named The Greenheart afterwards. In 1972 the Ministry of Housing and Spatial Planning published the Citizen Housing Memorandum. This Memorandum was the beginning of the 'bundled deconcentration' concept. This concept roughly consists of two things. Bundling through the development of new Dutch new towns in the city's immediate sphere of influence, as well as through the densification of metropolitan areas themselves. Deconcentration through the hierarchical distribution of groeikernen into functionally coherent urban areas based on the rank-size rule.

The Citizen Housing Memorandum had a keynote about how the urbanisation process should work in the Netherlands (MHSP, 1972):

"The responsible design of urban areas requires a close connection to what people want for their living environment. These wishes are very diverse; the future living environment will therefore have to be richly varied. In the current phase, more attention should be paid to the possibility of living in a single-family house on the outskirts of cities, where the advantages of urban life can be combined with those of a quiet outdoor living environment."

The interesting factor in this quote is that it states that living preferences differ over time. The current time should focus on single-family houses, but the urban areas still need to be varied so that new preferences can be fulfilled (MHSP, 1972). Table 4.1 shows the housing distribution in the Netherlands in 1970 and the preferences of the Dutch population. During that period, terraced houses were the most common form of housing, but people generally desired detached houses or bungalows as their first choice. New towns were developed with a focus on providing the housing types that aligned with people's preferences.

Figure 4.2: (1) Unite d'Habitation (FR), (2) Stevenage Town (UK), (3) The Garden City, (4) The City in History



Sources: Le Corbusier, n.d.; Woodrow, 2020; Howard, 1898; Mumford, 1961

Table 4.1: Housing distribution and preferences (in %) of the Dutch population in 1970.

	Current distribution	First preference	Second preference
Tower high-rise	1	0	0
High-rise	1	1	1
Medium-rise	12	2	1
Apartment	16	3	5
Elderly flat	0	1	3
Elderly home	1	4	4
Single-family home – detached	12	36	24
Single-family home – corner	17	9	19
Single-family home – terraced	31	11	12
Patio house	0	2	5
Bungalow	2	21	17
Farmhouse	3	7	6
Business house	1	1	1
Other	2	0	1

Source: Ministry of Housing and Spatial Planning, 1972 (edit)

Next to the ideas about the urbanization process, the Memorandum also sketched ideas on what the 'bundled deconcentration' process should look like (MHSP, 1972):

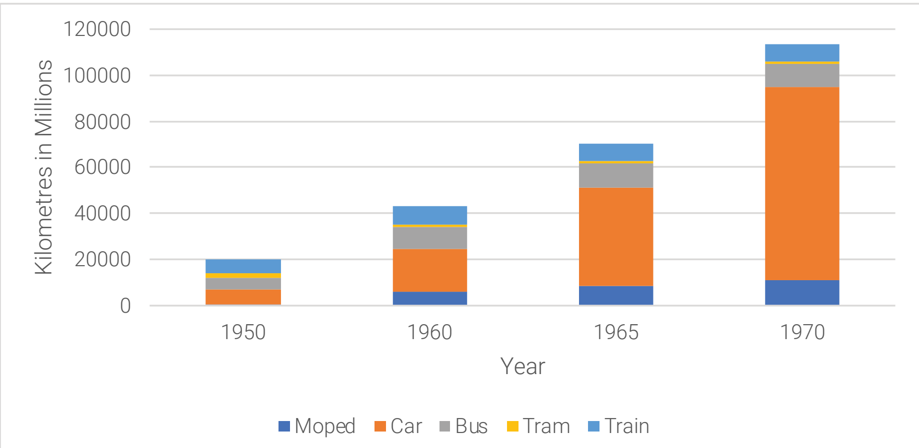
"In this concentration, however, the emphasis will not have to be on the densification of residential areas themselves, but first and foremost on thoughtful development of residential centres in the immediate sphere of influence of urban areas. In this way, residents can also be assured a good level of amenities in the long run, decent traffic and public transport and an attractive living environment, in which 'living outdoors' still speaks. Also, from an economic point of view, this form of urbanisation is more attractive than a strong sprawl due to cost advantages. It is also important that this does not put greater demands on space than is currently necessary, while still being able to meet today's housing wishes and needs."

The fact that this was the focal point of urbanisation at the time was dependent on multiple variables. There was a significant suburbanisation trend, which significantly impacted the city outskirts. Together with the suburbanisation of housing, office and retail space also left the cities (National Planning Service, 1972). Cities were losing their economically strong citizens and dynamic activities. The planned new towns should avoid this process. That way there should be renewed interest in city centres and more attention to the surrounding landscape. The meaning of 'bundled deconcentration' got more specific with the definition of 'groeikernen'. This definition goes as follows (Mackenzie & Peters, 1972):

"These are villages that, in order to achieve the desired urban pattern, need to grow as fast as possible, that more or less autonomous organic development is not enough and must give way to more project-based development."

New towns were planned through structure plans. This entailed the presence of a national framework that delineated the envisioned long-term (25-30 years) configuration of 'bundled deconcentration'. This included the foundational consensus among various tiers of government regarding the mid-to-long-term (15-year) development of the agglomeration (Mackenzie & Peters, 1972). This foundational consensus included the target per new town in terms of construction, replacement and renewal of houses, the pace of realisation, the consequences on car infrastructure and public transport, and how the further governance collaboration should look like. The bundled deconcentration was seen as the best option when taking the living preferences of people, less urban sprawl, healthy and thriving inner cities, and the use of public transport into consideration (Barendrecht & Nieuwenkamp, 1972). The optimal realisation varies by region. In 1972, numerous small towns in the Amsterdam region were undergoing development, necessitating enhanced government guidance. At that time the Netherlands also experienced a surge in automobile usage. Consequently, not all members of the Dutch government perceived the necessity of developing public transportation routes to the new towns (Hendriks et al., 1972). Figure 4.3 indicates that the distance travelled increased over a period of two decades, primarily because of suburbanisation, particularly the utilization of cars.

Figure 4.3: Travelled kilometers (in millions) by mode of transport



Source: Ministry of Housing and Spatial Planning, 1972 (edit)

4. RESULTS

4.1.3 PERIODS OF THE DUTCH NEW TOWNS

The evolving perspective on the optimal approach to urban development significantly influenced the final new towns. Notably, the initial new towns, including Zoetermeer, Lelystad, and Nieuwegein, prioritized traffic management. Later developed new towns, such as Houten and Hellevoetsluis, placed greater emphasis on the incorporation of green spaces and recreational facilities (Reijndorp et al., 2012). Table 4.2 shows an overview of all the final groeikernen in the Netherlands and in which Memoranda they are mentioned. In 1985, the favoured approach to urbanisation increasingly focused on the compact city model, yielding varying effects on the new towns (Ministry of Housing and Spatial Planning, 1985). Some experienced an upsurge in housing tasks while others witnessed a decline in housing tasks. Mainly influenced by their distance towards the adjacent city and public transportation availability.

The new town policy did work according to the number of new constructions in the Netherlands. In the timeframe of this policy, approximately between '65 – '85, lots of new construction took place. A distinct peak in new constructions is observed during the period spanning from 1972 to 1974, wherein a total of 460,058 houses were added within three years. While in the early 60's it was around 80.000 houses per year (CBS Statline, 2023a).

Table 4.2 Groeikernen and the Memoranda

Mentioned in Memorandum of...	1958*	'66	'72	'78	'85
Alkmaar	×	×	×	+	-
Almere	×	×	×	+	+
Capelle a/d IJssel**	•	•	•	-	+
Duiven-Westervoort	•	×	•	×	+
Haarlemmermeer	•	•	•	×	+
Hellevoetsluis	•	×	×	-	-
Helmond	•	•	•	×	+
Hoorn	×	×	×	+	-
Houten	•	×	×	+	+
Huizen	•	×	×	-	-
Lelystad	×	×	×	+	+
Nieuwegein	•	×	×	-	-
Purmerend	•	×	×	+	-
Spijkenisse	•	×	×	+	+
Zoetermeer	•	×	×	+	+

×	Mentioned as Groeikern
•	Is not mentioned as Groeikern
+	Mentioned as Groeikern with new or increased housing task
-	Mentioned as Groeikern with decreasing housing task

* The towns in 1958 are not mentioned as 'Groeikern' specifically, but as suitable towns that can grow.

** Capelle a/d IJssel is sometimes mentioned as Rijnmond Noord-Oost and includes parts of Rotterdam.

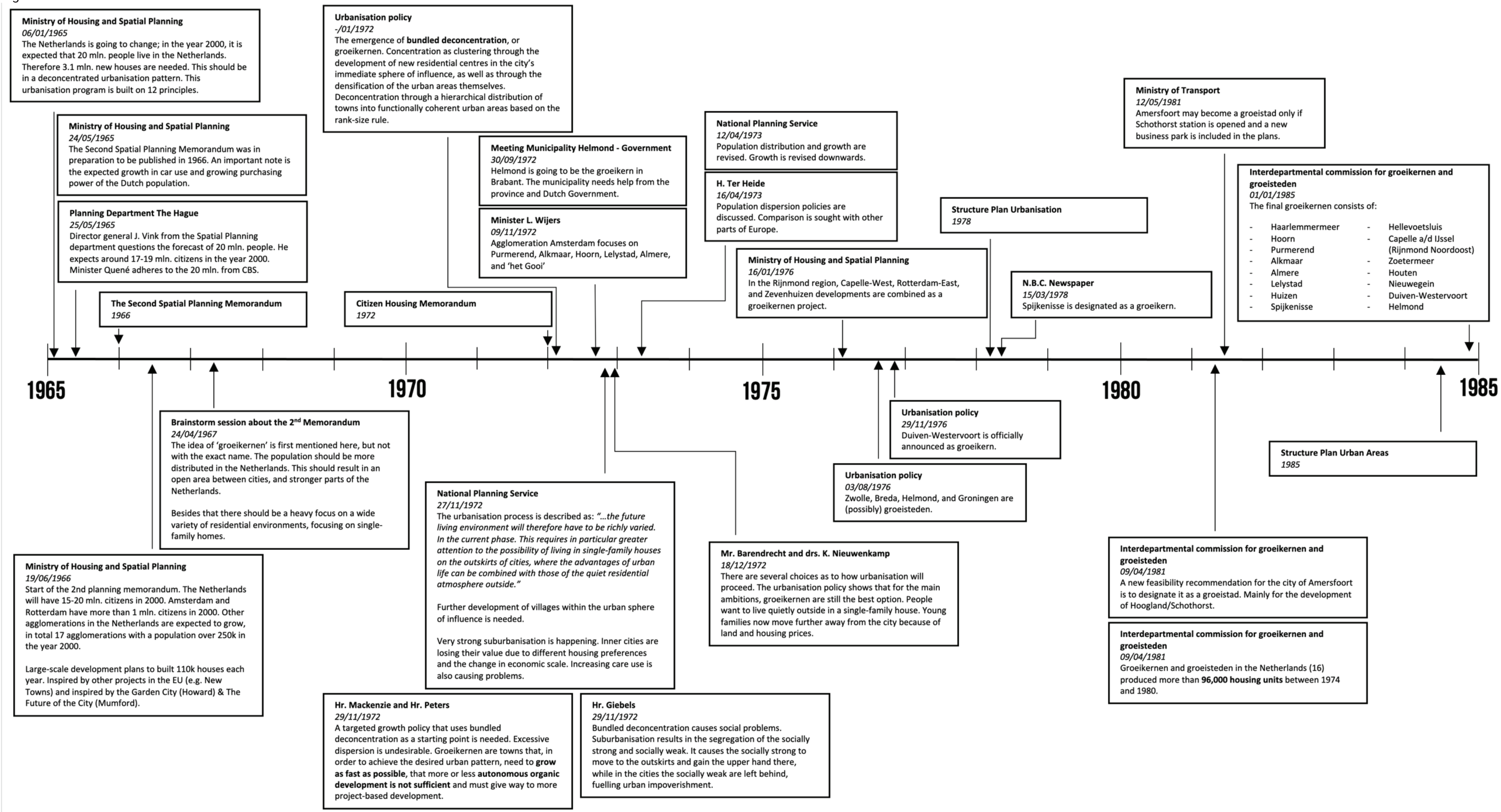
1958: De Ontwikkeling van het Westen des Lands (The Development of the West of the Country)
1966: Tweede Nota Ruimtelijke Ordening (The Second Spatial Planning Memorandum)
1972: Nota Volkshuisvesting (Citizen Housing Memorandum)
1978: Structuurschets verstedelijking (Structure Plan Urbanisation)
1985: Structuurschets stedelijke gebieden (Structure Plan Urban Areas)

Source: Reijndorp et al., 2012 (edit)

4.1.4 POLICY TIMELINE

The policy framework for the development of these new towns evolved gradually over time. It originated in 1965 with the recognition that the Netherlands would undergo significant change and growth, aiming to accommodate 20 million citizens in the year 2000. Centralised planning emerged as the solution, culminating in the concept of bundled deconcentration in 1972, which served as a strategy to facilitate housing expansion and construction. Specific locations were designated as "groeikernen" to serve as areas for growth. The following timeline in figure 4.5 provides an overview of the key events and milestones in this policy-making process.

Figure 4.5: Timeline with Dutch New Town events between 1965 and 1985



4.2 CHANGING DEMOGRAPHICS

This paragraph uses descriptive statistics to understand the change in demographics. The three columns at the right of table 4.3 show the changes between 1995 and 2022. The OAD is the number of addresses within a square kilometre. This measure is used in the Netherlands to see how urban certain areas are. This is relevant because an increase in OAD means that the new town is densified in the meantime, resulting in a larger population. A decreasing number is often related to the expansion of the municipality area and therefore is less dense compared to the years before.

4.2.1 POPULATION AND HOUSEHOLDS

The new towns in the Netherlands exhibit substantial differences across all measured factors. Firstly, there is a large variation in absolute population size, ranging from 14.944 to 217.828 individuals. Additionally, there is considerable heterogeneity in the degree of urbanity among these towns. For instance, Zoetermeer has the highest concentration of addresses per square kilometre, with 2.523 addresses, while Westervoort has the lowest, with only 1,159 addresses per square kilometre. There is also a great difference between the new towns in population growth. While Almere doubled in size, Huizen experienced a population decline. Despite all the changes in the new towns, the original 'groeikern' policy was already abandoned in the late 1980s.

Population growth differences among new towns in the Netherlands are influenced by various governmental growth strategies, new VINEX expansions, and local development plans. For instance, Almere, which boasts the largest population growth among all new towns, owes its growth largely to urban expansion plans implemented by the Dutch government. Almere presents an attractive location for building new housing. That is because of its proximity to Amsterdam, frequent high-quality public transport connections and easy highway access. Houten saw the second-largest growth among all new towns, which can be attributed to its designation as a VINEX location in the Utrecht region. Specifically, the southern part of Houten, which is almost as large as the northern part, was constructed between 2000 and 2020, leading to a remarkable 64% increase in population size. This is also the case with Purmerend, with their urban expansion called Weidevenne. Westervoort and Huizen are the two new towns that have experienced a decline in population. The primary reason for this is the lack of new housing developments since 1995. In addition, the household size has declined by approximately 30%, which further reduces the population size automatically. New towns like Hellevoetsluis, Zoetermeer, and Helmond, which scored average on population growth, underwent small-scale urban expansions after the 'groeikern' policy was officially ended. While Helmond and Zoetermeer both had VINEX expansions, their already large size meant that their relative growth was not

Table 4.3 Dutch new towns and their changing demographics *Source: CBS Statline, 2023b*

	1995			2022			Change		
	OAD	Househ. size	Population	OAD	Househ. size	Population	OAD	Househ. size	Population growth
Almere	1345	3,1	104.540	1620	2,3	217.828	20%	-26%	108%
Duiven	950	3,1	23.510	1185	2,3	24.946	25%	-26%	6%
Westervoort	1050	3,2	15.870	1159	2,2	14.944	10%	-31%	-6%
Houten	1264	3,4	30.740	1563	2,4	50.323	24%	-29%	64%
Nieuwegein	1711	3,2	58.150	1950	2,1	64.554	14%	-34%	11%
Alkmaar	1990	3,1	93.010	2314	2,1	110.783	16%	-32%	19%
Haarlemmer-meer	1160	3,1	104.270	1528	2,3	159.328	32%	-26%	53%
Hoorn	1376	3,1	61.370	1709	2,2	74.298	24%	-29%	21%
Huizen	1661	3,2	41.610	2048	2,2	40.938	23%	-31%	-2%
Purmerend	2051	3	65.030	2134	2,2	92.240	4%	-27%	42%
Capelle aan den IJssel	1975	3	60.500	2324	2,1	67.188	18%	-30%	11%
Hellevoetsluis	1405	3,1	36.690	1528	2,2	40.574	9%	-29%	11%
Spijkenisse	2038	3	70.750	1691	2,2	72.530	-17%	-27%	3%
Zoetermeer	2388	3,1	105.000	2523	2,2	125.767	6%	-29%	20%
Helmond	1466	3	73.600	1811	2,2	93.476	24%	-27%	27%
Netherlands	*-*	*2,4*	*15.424.122*	*2039*	*2,1*	*17.590.672*	*-*	*-13%*	*14%*
*G4**	*4372*	*1,9*	*1.999.031*	*4678*	*1,9*	*2.453.217*	*7%*	*0%*	*23%*

** The G4 shows the average/total of the 4 largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague & Utrecht)*

very high. In addition, household sizes in all new towns across the Netherlands have decreased, consistent with the countrywide trend of declining household size. However, the decline has been more pronounced in the new towns compared to the national average. This is because the average household size in the Dutch new towns was 3,1 in 1995, significantly higher than the 2,4 average in the rest of the country. Currently, the average household size in the new towns is 2,2, while in the Netherlands it is 2,1. Thus, the average household size in the Netherlands has decreased by 13%, while in the new towns, it has dropped by 29%. As a result of this decline, there is now one fewer person living in every household in the new towns compared to 27 years ago. The magnitude of this change is significantly greater when compared to the adjacent cities. In contrast, the four largest cities in the Netherlands have maintained remarkable stability in terms of household size. Since 1995, the average household size has remained constant at 1,9 people, which is still the case today. The Dutch new towns are not stable, and this decrease in household size could have implications for facility levels. In the following paragraphs, the relationship between demographics and facility levels is analysed.

4.2.2 AGE GROUPS

Household decline and ageing in Dutch new towns are exceptional phenomena compared to the rest of the Netherlands. The Netherlands also suffers from ageing, but to a less extent compared to the new towns. In figure 4.6 until 4.9 on page 49 it can be seen that new towns had more than average people between 0 and 10 years old, as well as people between 30 and 40 years old, suggesting that young families lived there. The black line represents the Dutch average at that time. The pyramids on the left represent the year 1995, while the pyramids on the right depict the year 2021 (CBS, 2023). These new towns stand out due to their unique demographic trends, resulting in specific difficulties. Furthermore, there is a difference between the new towns when solely considering population growth and address density. Some new towns continue to expand through contemporary urban expansions, making them increasingly larger. This is for example in Purmerend and Houten. On the other hand, it is interesting to note that certain new towns have seen minimal new construction since the 1990s, such as Westervoort or Huizen. This dynamic between new towns, where some continue to grow while other experience stagnation, provides an intriguing insight into the diversity of urban developments in the Netherlands. There appears to be a correlation between ongoing development and the age composition of the population. Upon comparing the new towns of Utrecht, it becomes evident that Houten exhibits a larger proportion of residents between the ages of 0 and 10, as well as 10 and 20, surpassing the Dutch average. Conversely, Nieuwegein, which did not undergo substantial growth, has experienced a more rapid ageing process with a larger than average group of citizens that are 60 years or older (figure 4.6 & 4.7).

4.3 ANALYSIS OF DEMOGRAPHICS AND FACILITIES

As discussed in section 4.2, there have been changes in demographics over time. Regression analyses were conducted to evaluate how demographics influence facilities. To ensure the validity of the results, a preliminary step involved assessing whether the data satisfied the assumptions of linear regression. The examination of the collinearity assumption revealed no concerns about multicollinearity, and the corresponding values can be found in Appendix 1 up to and including 14 The standardized residuals' histogram demonstrated that the data exhibited errors that were approximately normally distributed. This observation was further supported by the normal P-P plot of standardized residuals, which displayed points that were closely aligned with the expected line, albeit not entirely. The scatterplot of standardized predicted values indicated that the data satisfied the assumptions of homogeneity of variance and linearity. The assumption of non-zero variances was also met, and the respective values can be found in Appendix 1 up to and including 14. To ensure robustness, all analyses were meticulously filtered to identify any outliers, using a maximum standardized residual threshold of 3.0. Considering the significant spatial disparities in the Netherlands, characterized by varying values across different regions, this threshold was preferred over the conventional 2 standardized residuals. All regressions on facilities encompassed 2 versions, one version that included the postal codes within the Dutch new towns, and one version with the remaining postal codes in the Netherlands. The selected variables per regression are based on the observed relationships between specific facilities and certain demographic aspects in the literature. Therefore, not all regressions consist of the same independent variables.

4.3.1 EDUCATIONAL FACILITIES

Elementary schools

Multiple regression was conducted to see if age, population development, households with children, and address density predicted the number of schools per postal code. Both models were significant. The new town model F(5, 148) = 21.39, p < .01, R2 = .42, $R^2_{Adjusted}$ = .40) (table 4.4) had a smaller $R^2_{Adjusted}$ compared to the Netherlands (F(5, 3129) = 6695.29, p < .00, R2 = .92, $R^2_{Adjusted}$ = .91) (table 4.5). Within new towns only address density significantly predicts the number of schools within a postal code ($B_{std.}$ = .73, t(152) = 9.50, p < .05) as seen in table 4.4. Which means that demographics have no significant role in predicting elementary schools, this is contradictory to the literature, where is stated that there is a relationship between these variables. In the Netherlands, all demographic variables are significant in predicting the number of schools, with people aged 65 years or older having the largest negative effect of all demographics ($B_{std.}$ = -.09, t(3134) = -9.33, p = .000). Interestingly, the regression analyses do not show any significant correlation between age and number of elementary schools. The field research showed that different new towns experienced abandoned schools, or schools that changed their function partly. An example is the elementary school Krullevaar in the Doorslag neighbourhood in Nieuwegein (figure 4.10*). The school is not being used anymore and is now occupied by anti-squatting residents. A lot more examples are there in Nieuwegein such as Zuiderkroon and Uniq in Fokkesteeg, Vogelnest in Doorslag, Margrietschool in Batau, and Ziezo in Hoog-Zandveld. And this is only in Nieuwegein. In Purmerend there are also at least eight closed schools, with most of them in Overwhere, a 70s neighbourhood (figure 4.11). In Duiven (figure 4.13) a former elementary school has been demolished, and replaced with newly

Table 4.4: Regression elementary schools in new towns

	Std. coefficients	t-value	p-value
(Constant)		.133	.894
OAD	0.731	9.500	**.000**
015jaar	0.097	.867	.387
65jaar	-0.178	-1.838	.068
Bevolkingsontw.	0.017	.263	.793
HHmetKind	0.149	1.492	.138

Table 4.5: Regression elementary schools in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		-1.343	.179
OAD	.995	132.456	**.000**
015jaar	.041	3.704	**.000**
65jaar	-.093	-9.329	**.000**
Bevolkingsontw.	.014	2.528	**.012**
HHmetKind	.051	7.173	**.000**

*Figure 4.10 - 4.21 on p. 50-51

built houses. Some new towns give other functions to empty school rooms while keeping the school function. This happened at Het Parelhof in Purmer-Noord in Purmerend, as seen in figure 4.11. Empty classrooms were filled with a library and a childcare centre. Conversely, in rapidly expanding new towns like Almere, schools are resorting to the use of temporary buildings to accommodate the influx of new students (figure 4.15).

The field research shows that the regression model does not always reflect reality. Schools that use their empty classrooms for other functions will still be counted as a school in the dataset. However, they still changed due to a lack of school-going children. On the other hand, certain new towns have already met the minimum requirement of supply in schools, indicating that further decreases in the supply are unlikely to occur. For example in Westervoort, this new town supports five elementary schools. They all have a different perspective on education, such as Jenaplan, Montessori, and different religious beliefs. This makes a fusion between schools also less likely to happen.

High schools

Multiple regression was conducted to see if age, population development, households with children, and address density predicted the number of high schools per postal code. Both models were significant with the new town model (F(5, 151) = 23.947, p < .001, R^2 = .44, $R^2_{Adjusted}$ = .42) (table 4.6) having a smaller $R^2_{Adjusted}$ compared to the Netherlands (F(5, 3054) = 3003.028, p < .000, R^2 = .83, $R^2_{Adjusted}$ = .83) (table 4.7). Both households with children (B_{std}. = -.26, t(156) = -2.80, p < .01), and population development ($B_{std.}$ = .14, t(156) = 2.20, p <.05) were significant demographic variables in predicting the number of high schools in new towns, with households with children having the largest negative effect. In the Netherlands age and households with children were significant in predicting the number of high schools, while population development was not. The number of children had the largest negative effect ($B_{std.}$ = -.08, t(3059) = -5.24, p < .001) on predicting high schools in the Netherlands. Both models encompass logical connections as well as some illogical ones. Once again, the OAD proved to be the most influential factor when it comes to impacting schools as seen in tables 4.6 and 4.7. This is highly logical, as a greater number of addresses typically leads to a higher population and an increased number of school-aged children. This is also confirmed by Abdi-Daneshpour (1983) who states that population growth influences the number of educational facilities. However, it is illogical that age, similar to elementary schools, is not a significant factor in relation to high schools in new towns. This is opposed to Abdi-Daneshpour (1983), who states that age-related demographics do have a certain effect on educational facilities. The field research does reveal certain high schools that are experiencing a decline in student enrollment or are even closing down, such as the case of Anna van Rijn high school in Nieuwegein (figure 4.16). Therefore, field research confirms the statemements that are made in the literature. Interestingly, within the Netherlands itself, there exists a negative correlation between individuals aged 0 to 15 years and high schools, which appears contradictory. Conversely, there is a plausible negative association between individuals aged 65 years or older and the number of high schools.

In addition to the decline in student enrollment, certain new towns face challenges when it comes to investing in educational facilities. For example in Almere, as seen in figure 4.18, where some schools are grappling with overdue maintenance. This issue arises

Table 4.6: Regression high schools in new towns

	Std. coefficients	t-value	p-value
(Constant)		2.363	.019
OAD	.561	7.484	**.000**
015jaar	.060	.572	.568
65jaar	-.091	-.994	.322
Bevolkingsontw.	.139	2.198	**.029**
HHmetKind	-.260	-2.796	**.006**

Table 4.7: Regression high schools in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		1.310	.190
OAD	.956	91.661	**.000**
015jaar	-.082	-5.236	**.000**
65jaar	-.039	-2.737	**.006**
Bevolkingsontw.	.005	.699	.485
HHmetKind	-.024	-2.356	**.019**

from the tendency of new towns to construct numerous schools simultaneously during their development in the 1970-1980s. Consequently, a lot of schools require renovation at the same time. However, due to the simultaneous need for renovations across all schools, new towns often encounter financial constraints in supporting these attempts (Mienstra, 2021). Some new towns that are near each other share a high school. For example in figure 4.17, where Candea college serves students from both Duiven and Westervoort.

Childcare centres

Multiple regression was conducted to see if age, population development, households with children, and address density predicted the number of childcare centres per postal code. Both models were significant with the new town model ($F(5, 151) = 11.94$, $p < .001$, $R^2 = .28$, $R^2_{Adjusted} = .26$) (table 4.8) having a smaller $R^2_{Adjusted}$ compared to the Netherlands ($F(5, 3156) = 1537.74$, $p < .000$, $R^2 = .71$, $R^2_{Adjusted} = .71$) (table 4.9). Within new towns address density ($B_{std.} = .48$, $t(156) = 5.58$, $p < .001$), people between 0 and 15 years old ($B_{std.} = .30$, $t(156) = 2.52$, $p < .05$)., people aged 65 years or older ($B = -.33$, $t(156) = -3.19$, $p < .01$), and population development ($B_{std.} = -.17$, $t(156) = -2.33$, $p < .05$) significantly predict the number of childcare centres per postal code as seen in table 4.8. People aged 65 years or older have the largest negative effect of all demographic variables. According to table 4.9, all demographic variables in the Netherlands were significant except the number of households with children. The number of children between 0 and 15 years old has the largest positive effect on childcare centres ($B_{std.} = .22$, $t(3161) = 10.62$, $p < .001$).

The regression findings align with existing literature, indicating a positive relationship between the number of children and the presence of childcare centres. This pattern holds true not only in Dutch new towns but also across the Netherlands. Conversely, an increase in the population of individuals aged 65 years or older leads to a decrease in the number of childcare centres. However, one surprising finding emerges: population growth correlates with a reduction in childcare centres. This observation is particularly intriguing for Dutch new towns, where newly constructed housing predominantly comprises single-family homes that attract young families with children. In reality this might be different.

The childcare centres in new towns are often built together or merged with existing elementary schools. They are called an IKC, which means integrated childcare centre. These locations provide education and all sorts of childcare options, such as after-school, between-school, or a playgroup for younger ages (figure 4.19 & 4.20). Some childcare centres are still stand-alone buildings, such as in figure 4.21.

Table 4.8: Regression childcare centres in new towns

	Std. coefficients	t-value	p-value
(Constant)		.262	.794
OAD	.475	5.582	**.000**
015jaar	.299	2.518	**.013**
65jaar	-.332	-3.192	**.002**
Bevolkingsontw.	-.167	-2.328	**.021**
HHmetKind	.139	1.332	.188

Table 4.9: Regression childcare centres in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		5.386	.000
OAD	.755	54.403	**.000**
015jaar	.223	10.617	**.000**
65jaar	-.082	-4.318	**.000**
Bevolkingsontw.	-.046	-4.631	**.000**
HHmetKind	-.013	-.996	.319

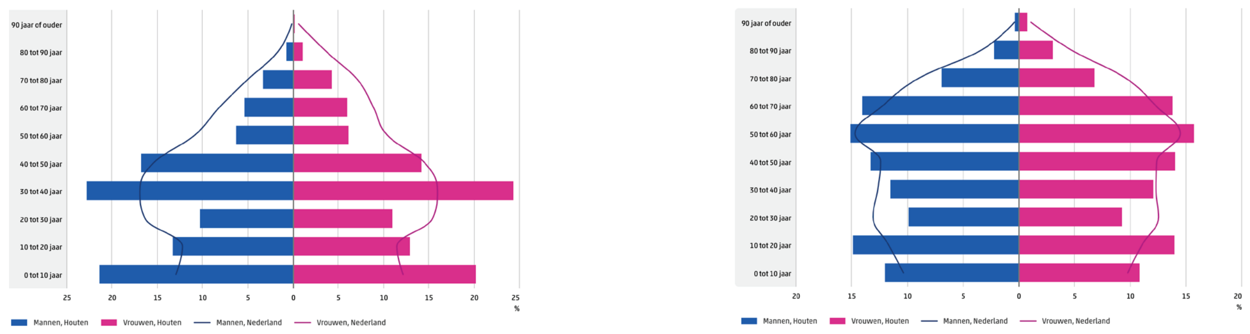


Figure 4.6: Population pyramid of Houten (CBS, 2023).

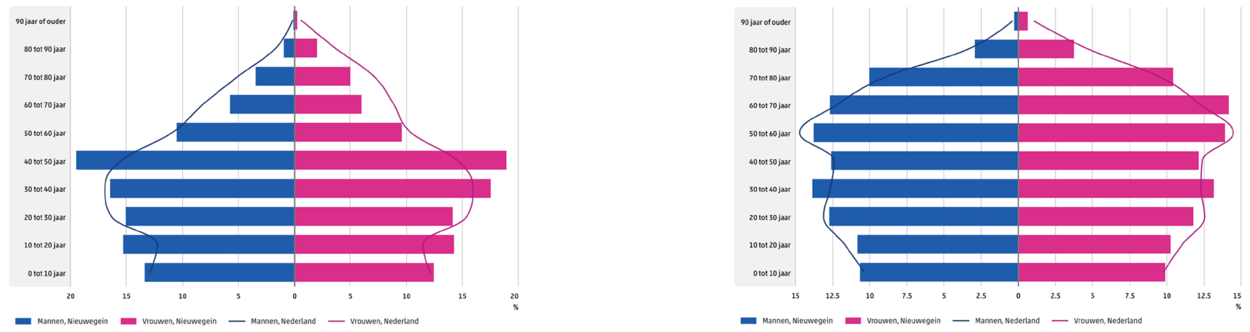


Figure 4.7: Population pyramid of Nieuwegein (CBS, 2023).

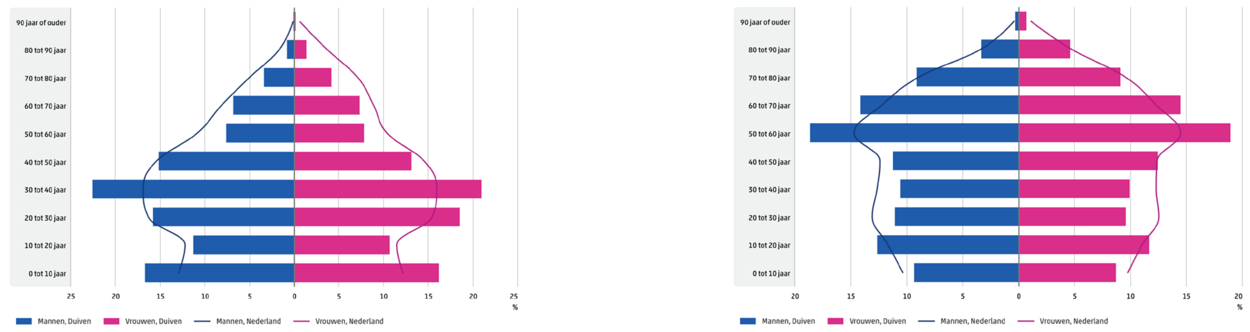


Figure 4.8: Population pyramid of Duiven (CBS, 2023).

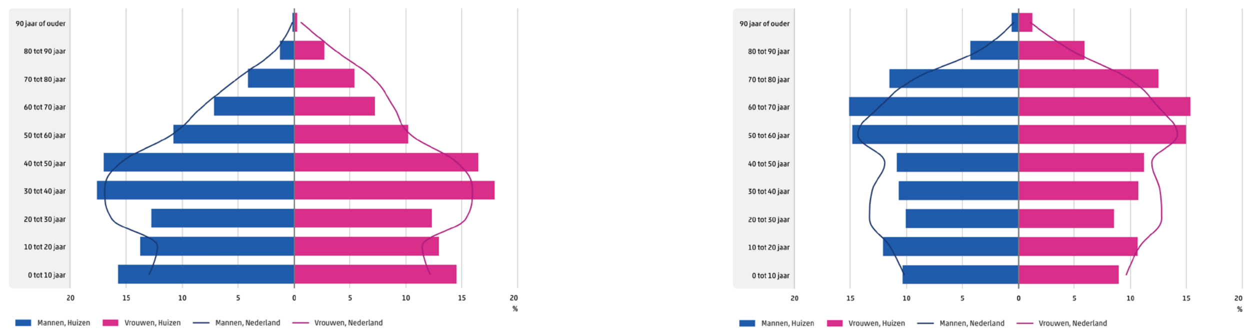


Figure 4.9: Population pyramid of Huizen (CBS, 2023).


Figure 4.10: Closed elementary school De Krullevaar in Nieuwegein, Doorslag.


Figure 4.11: Different functions in a school building in Purmerend. Unused classrooms are filled with functions such as a library and a childcare centre.


Figure 4.12: Former elementary school in Purmerend that is now being used as housing for Ukranian refugees.


Figure 4.13: New rowhouses being built in Duiven on a former plot that contained an elementary school.


Figure 4.14: Abandoned elementary school in Purmer-end, Purmer-Zuid.


Figure 4.15: Temporary school facility due to a sudden increase in children in the growing city of Almere, de Griend.


Figure 4.16: Closed high school Anna van Rijn in Nieuwe-gein, de Wiers.


Figure 4.17: Candea College in Duiven, with direct bicycle path towards Westervoort.


Figure 4.18: Outdated high school De Meergronden in Al-mere-Haven. It suffers from overdue maintenance due to financial problems in the municipality (Mienstra, 2021). The high school is still in use.


Figure 4.19: Elementary school in Purmerend, Purm-er-zuid is now also facilitating a childcare centre in its empty classrooms.

Figure 4.20: Childcare centre in Nieuwegein, Batau. All ages are facilitated in this building, as well as an elemen-tary school.

Figure 4.21: Small childcare centre in Purmerend, Leegh-waterpark.

4.3.2. HEALTHCARE FACILITIES

General practices

To understand whether healthcare facilities are prone to changes in demographics, multiple regression was conducted to see if household size, age, population development, and address density predicted the number of general practices per postal code. General practices are small-scale health facilities that work on neighbourhood level. Therefore, they are the best way top measure healthcare per postal codes. Both models were significant with the new town model ($F(5, 161) = 60.590$, $p < .001$, $R^2 = .65$, $R^2_{Adjusted} = .64$) (table 4.10) having a smaller $R^2_{Adjusted}$ compared to the Netherlands ($F(5, 3483) = 6112.303$, $p < .000$, $R^2 = .90$, $R^2_{Adjusted} = .90$) (table 4.11). Within new towns only age was a significant demographic value, with people aged between 0 and 15 years old ($B_{std.} = -.148$, $t(166) = -2.204$, $p < .05$) having a slightly larger effect compared to people aged 65 years or older ($B_{std.} = .137$, $t(166) = 2.014$, $p < .05$), as seen in table 4.10. In the Netherlands all demographic variables were significant in predicting the number of general practices, except for household size as evidenced by table 4.11. People aged 65 years or older had the largest effect on general practices in the Netherlands ($B_{std.} = -.112$, $t(3488) = -10.74$, $p = .000$).

According to Kis et al. (2017), an older population leads to a higher demand for health facilities. Analysis of data in Dutch new towns supports this claim, as an increase in older individuals is associated with a greater number of general practices. Conversely, a younger population is linked to a lower number of general practices. This finding is consistent with the research conducted by Yeganeh (2019), which suggests that ageing populations place increased pressure on healthcare systems. The analysis of general practices in the Netherlands reveals contrasting outcomes. Both older and younger populations exhibit a negative correlation with the number of general practices. However, a significant relationship with population growth still exists. This finding is supported by Salam's (2019) research, which suggests that rapid declines or increases in the population have an impact on the number of health facilities.

Something that often occurs in the observations during the field research, is that health facilities are sometimes severely outdated. Certain locations still utilize the original buildings, in the original state, dating back to when they were initially constructed. For example, the pharmacies in figure 4.24 and 4.25, and also the retirement home in figure 4.26. Simultaneously, numerous existing facilities are undergoing renovations, demolitions, or relocations. For instance, the former healthcare centre in the Purmer-noord neighbourhood of Purmerend (figure 4.22) has been relocated to a newly constructed building within the same neighbourhood. The healthcare centre in Nieuwegein, Zandveld underwent a comprehensive renovation, as observed in figure 4.23. Additionally, the nursery and retirement homes in Duiven were demolished and replaced with new facilities featuring increased capacity and improved amenities to cater the growing elderly population (figure 4.27).

Table 4.10: Regression general practices in new towns

	Std. coefficients	t-value	p-value
(Constant)		.288	.774
OAD	.777	13.604	**.000**
015jaar	-.148	-2.204	**.029**
65jaar	.137	2.014	**.046**
Bevolkingsontw.	.073	1.537	.126
HHgrootte	-.008	-.150	.881

Table 4.11: Regression general practices in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		.332	.748
OAD	1.034	130.03	**.000**
015jaar	-.046	-4.230	**.000**
65jaar	-.112	-10.739	**.000**
Bevolkingsontw.	.025	4.388	**.000**
HHgrootte	.008	1.116	.265

Figure 4.22: Former healtcare centre in Purmerend, Purmer-noord. Moved towards newer building 800 meters to the north.

Figure 4.23: Redeveloped healthcare centre in Nieuwegein, Zandveld.

Figure 4.24: Pharmacy in Purmerend, Wheermolen. Built at the same time as the neighbourhood in 1973.

Figure 4.25: Pharmacy in Nieuwegein, Batau-noord. Built at the same time as the neighbourhood in 1983.

Figure 4.26: Retirement home 'De Overloop' in Almere-Haven. The building was developed in 1984.

Figure 4.27: Thuvine Park in Duiven. Old nursery- and retirement homes were completely renovated and expanded.

4.3.3 LEISURE & RETAIL FACILITIES

Cafés

Multiple regression was conducted to see if household size, age, population development, the proximity of a train station and address density predicted the number of cafés per postal code. Both models were significant with the new town model in table 4.12 ($F(5, 149) = 8.719$, $p < .001$, $R^2 = .23$, $R^2_{Adjusted} = .20$) having a smaller $R^2_{Adjusted}$ compared to the Netherlands ($F(5, 3097) = 912.415$, $p < .000$, R2 = .60, $R^2_{Adjusted} = .60$) in table 4.13. Within new towns only household size was a significant demographic variable in predicting cafés ($B_{std.} = -.167$, $t(154) = -2.028$, $p < .05$). In the Netherlands all variables were significant except the proximity of a train station. The population between 15 and 25 years old had the largest negative effect of all demographic variables ($B_{std.} = -.209$, $t(3102) = -12.540$, $p = .000$).

It is intriguing to note that age and population growth do not exhibit significant correlations with the presence of cafés in Dutch new towns. Only household size demonstrates a significant relationship, albeit in a negative direction, this relation is also found in the Netherlands. This implies that larger households are associated with fewer cafés. This observation could be attributed to the fact that cafés are typically situated in city centres, where housing units often consist of apartments with fewer rooms. Consequently, household sizes tend to be smaller in city centres, while the number of cafés is higher. This could potentially explain this otherwise puzzling finding, as larger household sizes would eventually lead to a greater population and, in turn, more potential customers for cafés. Examples of this can be found in figure 4.31*, showcasing the presence of various cafés within City Plaza, located in the city centre of Nieuwegein. Similarly, in figure 4.36, in Almere-Buiten, the ground floor of an apartment building has been purposed to accommodate cafés and other forms of hospitality. However, in some new towns there are some cafés located outside of the city centre, such as in Purmerend, de Gors (figure 4.34).

Cafeterias

Multiple regression was conducted to see if household size, age, population development, the proximity of a train station and address density predicted the number of cafeterias per postal code. Both models were significant with the new town model ($F(6, 151) = 10.111$, $p < .001$, $R^2 = .29$, $R^2_{Adjusted} = .26$) (table 4.14) having a smaller $R^2_{Adjusted}$ compared to the Netherlands ($F(6, 3391) = 1182.620$, $p < .000$, $R^2 = .68$, $R^2_{Adjusted} = .68$) (table 4.15). Within the new towns household size and population development were significant variables, with household size having the largest effect on predicting cafeterias ($B_{std.} = -.193$, $t(157) = -2.433$, $p < .05$). For the Netherlands all demographic variables were significant in predicting the number of cafeterias, as well as the proximity of a train station. People aged 65 years or older had the largest positive effect ($B_{std.} = .352$, $t(3397) = 18.616$, $p = .000$).

Table 4.12: Regression cafés in new towns

	Std. coefficients	t-value	p-value
(Constant)		2.485	.014
OAD	.392	4.652	**.000**
1525jaar	-.059	-.715	.476
Bevolkingsontw.	-.001	-.016	.987
HHgrootte	-.167	-2.028	**.044**
Treinstation	-.125	-1.441	.152

Table 4.13: Regression cafes in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		9.958	.000
OAD	.877	48.912	**.000**
1525jaar	-.209	-12.540	**.000**
Bevolkingsontw.	-.046	-3.922	**.000**
HHgrootte	-.097	-7.951	**.000**
Treinstation	.008	1.116	.241

Table 4.14: Regression cafeterias in new towns

	Std. coefficients	t-value	p-value
(Constant)		2.264	.025
OAD	.420	4.993	**.000**
1525jaar	-.066	-.604	.547
65jaar	.102	.919	.359
Bevolkingsontw.	.160	2.243	**.026**
HHgrootte	-.193	-2.433	**.016**
Treinstation	-.071	-1.006	.316

Table 4.15: Regression cafeterias in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		9.678	.000
OAD	.610	40.433	**.000**
1525jaar	-.113	-5.576	**.000**
65jaar	.352	18.616	**.000**
Bevolkingsontw.	-.030	-2.997	**.003**
HHgrootte	-.115	-10.529	**.000**
Treinstation	.041	3.969	**.000**

*Figure 4.28 - 4.39 on p. 26-57

During the development phase of Dutch new towns, the establishment of cafeterias was deliberately incorporated (Provoost, 2022). The lack of significance regarding age is therefore not unexpected since the inclusion of cafeterias was pre-planned. As the population ages or becomes younger, the availability of space for cafeterias does not suddenly change. In figure 4.34 and 4.35 it can be seen that cafeterias are implemented in an apartment complex, as well as in a neighbourhood centre. Compared to the Netherlands, this result is very different. People aged 65 years or older actually lead to an increase in the number of cafeterias, while younger individuals are associated with a decrease. The variable representing the population aged 65 years or older has a relative big weight, indicated by its t-value of 18, in comparison to the other variables.

Everyday food & drug stores (ef&d)

Multiple regression was conducted to see if household size, age, population development, the proximity of a train station and address density predicted the number of ef&d stores per postal code. Both models were significant with the new town model in table 4.16 ($F(6, 158) = 46.107$, $p < .001$, $R^2 = .64$, $R^2_{Adjusted} = .62$) having a smaller $R^2_{Adjusted}$ compared to the Netherlands in table 4.17 ($F(6, 3235) = 5460.605$, $p < .000$, R2 = .91, $R^2_{Adjusted} = .91$). Within new towns age, and the proximity to a train station had a significant effect on ef&d stores. People aged between 15 and 25 years old have the largest negative effect on the number of these stores ($B_{std.} = -.275$, $t(164) = -3.591$, $p < .01$). In the Netherlands all demographics and the proximity of a train station had a significant effect on ef&d stores, except for population development. The proximity of a train station had the largest negative effect ($B_{std.} = -.027$, $t(3241) = -4.846$, $p = .000$). This means that more younger people result in less stores, and more elderly result in more stores. This is in line with existing research (Tyrväinen & Karjaluoto, 2022).

The data analysis did not reveal some crucial factors regarding retail in new towns. It has been discovered that people often choose to travel to larger cities for clothing and other non-daily necessities (Demaziere, 2022). This significantly impacts the number of vacant storefronts in Dutch new towns. Duiven and Purmerend experience this phenomenon.They face strong competition from Arnhem and Amsterdam as prominent cities that attract visitors. As a result, the shopping malls in these new towns suffer from vacant storefronts (see figure 4.30 & 4.42). On the other hand, Almere and Nieuwegein, both having the allure of relatively large cities, do not experience this phenomenon. Figure 4.28 illustrates the city centre of Almere, while figure 4.31 showcases Nieuwegein with its expansive mall. It is important to bear in mind that when it comes to daily needs, proximity to facilities is of utmost importance (Amrit, 2021). This observation is further supported by field research, as even in new towns with a significant number of vacant stores, essential services for daily needs remain accessible. Supermarkets, drug stores, and other essential businesses are always available (figure 4.29 & 4.33).

Parks

Parks form an integral part of the recreational infrastructure found in towns. As an essential component, they were incorporated into the initial planning stages of all Dutch towns (Provoost, 2022). Therefore they are not influenced by changing demographics. Figures 4.38 and 4.39 show parks in Duiven and Purmerend.

Table 4.16: Regression of ef&d stores in new towns

	Std. coefficients	t-value	p-value
(Constant)		1.873	.063
OAD	.699	11.809	**.000**
1525jaar	-.275	-3.591	**.000**
65jaar	.207	2.682	**.008**
Bevolkingsontw.	.018	.373	.710
HHgrootte	-.087	-1.528	.128
Treinstation	-.155	-3.151	**.002**

Table 4.17: Regression of ef&d stores in the Netherlands

	Std. coefficients	t-value	p-value
(Constant)		3.643	.000
OAD	1.067	124.61	**.000**
1525jaar	-.047	-3.904	**.000**
65jaar	-.151	-13.534	**.000**
Bevolkingsontw.	-.010	-1.811	.070
HHgrootte	-.017	-2.714	**.007**
Treinstation	-.027	-4.846	**.000**

Figure 4.28: City centre of Almere-Stad. Almere is the largest new town in the Netherlands with a population of 224.000 citizens.


Figure 4.29: Neighbourhood shopping street in Nieuwegein, Batau. Mainly consists of shops that provide daily needs.


Figure 4.30: The city centre of Duiven suffers from vacant storefronts.


Figure 4.31: The city centre of Nieuwegein called City Plaza. Popular city centre in the Utrecht region, which results in less vacant shops.


Figure 4.32: Almost empty shopping centre Makado in Purmerend, Wheermolen.


Figure 4.33: Neighbourhood shopping centre in Almere, Muziekwijk. Only includes shops that provide daily needs.


Figure 4.34: Cafeterias and cafés in Purmerend, de Gors. They are located outside of the city centre.

Figure 4.35: Cafeteria next to the busstation in Purmerend, Tramplein.


Figure 4.36: Newly constructed apartment building, with cafés and restaurants on the ground floor in the centre of Almere-Buiten.


Figure 4.37: Cultural centre ‘Corrosia’ in the centre of Almere-Haven. It includes, among other things, a library and a theater.


Figure 4.38: Planned municipal park called “Gemünden am Main Park’ in Duiven.


Figure 4.39: Planned municipal park called ‘Leeghwaterpark’ in Purmerend, Purmer-noord.

4.3.4 REGRESSION REMARKS

The regression results yielded distinct findings when examining the new towns separately from the Netherlands. These outcomes demonstrated contrasting implications for the hypotheses put forth in paragraph 3.3. This paragraph discusses whether the alternative hypotheses could be accepted or not.

The null hypothesis (H0) posited that demographics and address density would not have a significant impact on the number of educational facilities. However, this hypothesis is rejected for both educational facilities in Dutch new towns and the Netherlands. While the specific variables demonstrating significance may differ, both regions exhibit some variables that significantly influence the number of educational facilities. When examining elementary schools, an intriguing observation emerges in new towns, where none of the demographic variables displays significance. Only address density exhibits a positive effect, indicating that a higher density of addresses corresponds to a greater number of schools. In contrast, the other Dutch postal codes demonstrate a positive relationship between the number of children and more schools, while an increase in the proportion of individuals aged 65+ correlates with fewer schools. Additionally, Dutch postal codes exhibit a positive association with population growth and households with children.

Second, the regressions conducted on high schools yield consistent results across models. Both new towns and the Netherlands exhibit a positive and significant effect of address density on the number of high schools. Furthermore, both models reveal a significant negative relationship between households with children and high schools, indicating that a higher concentration of households with children corresponds to a lower number of high schools—a somewhat unexpected finding. Notably, while the Dutch postal codes exhibit a significant relationship between age and high schools, this association is not observed in Dutch new towns.

Turning to day nurseries, the regression analyses reveal similarities between new towns and the Netherlands. In both cases, age and population development emerge as significant factors in predicting the number of day nurseries. Specifically, an increase in the number of children leads to a higher number of day nurseries, while a larger proportion of individuals aged 65+ corresponds to a decrease in the number of day nurseries. Considering educational facilities, specific variables and their relationships vary across facility types and regions, highlighting the nuanced influences shaping educational provision in different areas.

Next, the health facilities, specifically general practices were investigated. Similar to before, the null hypothesis (H0) proposed that demographic variables and address density would not impact the number of health facilities. However, this null hypothesis can be rejected based on the regression analyses. Both regression models yielded significant results regarding demographics and address density. In both models, address density exhibited a positive effect, indicating that a higher density of addresses corresponds to a greater number of general practices. Additionally, a negative effect was observed for the variable related to children in both regressions, suggesting that an increase in the number of children is associated with a lower number of general practices. However, there were differences when it came to individuals aged 65 years or older. In the case of new towns, an increase in the number of people aged 65 or older was found to correlate with more general practices. Conversely, on a national scale, the relationship was negative. Considering population development, the Netherlands exhibited a positive correlation with the number of general practices. This relationship was not found in new towns.

Moving on to the analysis of leisure and retail facilities, the null hypothesis proposed no relationships between demographics, address density, proximity to a train station, and the number of leisure and retail facilities. However, the null hypothesis can be rejected as all regression models show some significant results for both new towns and the Netherlands. In examining cafes, address density once again emerges as a significant factor in both new towns and the Netherlands, positively correlating with the number of cafes. Additionally, in new towns, household size is also significant, showing a negative effect on the number of cafes. This implies that larger households are associated with a lower number of cafes, a finding consistent with the results in the Netherlands. In the Netherlands, two significant negative correlations are observed: one between the number of cafes and the population aged between 15 and 25 years, and another between population growth and the number of cafes. This suggests that in the Netherlands, a higher proportion of individuals aged 15-25 and a faster population growth correspond to a lower number of cafes. This is not observed in the new towns.

Second, let's consider the analysis of cafeterias. In new towns, address density and population development exhibit positive correlations with the number of cafeterias, while household size shows a negative correlation. Conversely, in the Netherlands, all independent variables are found to be significant. Of particular interest is the fact that population development, unlike in new towns, is negatively correlated with the number of cafeterias.

The regression analyses conducted on ef&d stores reveal correlations in both new towns and the Netherlands. Address density demonstrates a positive correlation with ef&d stores in both regions. Additionally, two variables show contrasting relationships between the two regions: people aged 65 years or older and household size. In new towns, an increase in the number of older individuals correlates with a greater number of ef&d stores, while in the Netherlands, the relationship is negative. This implies that a higher proportion of older people is associated with a lower number of ef&d stores in the Netherlands. Regarding household size, the analyses show a significant on negative correlation in the Netherlands but not in new towns. Furthermore, two additional variables exhibit correlations in both regions. People between 15-25 years old and proximity to a train station are negatively associated with the number of ef&d stores.

These findings highlight the significant impact of demographics on the provision of facilities. It is interesting because they demonstrate that the relationship between demographics and facilities is not static, but rather subject to change over time. Looking back at the policy from paragraph 4.1.2, the MHSP assured in 1972 that residents would always have access to a good level of facilities in the long run, while the research findings indicate that demographic shifts can still influence the availability and quality of facilities.

Figure 4.40 Swimmingpool 'Het Hoogwerf' in Spijkenisse, 1983 *Source: Streekarchief Voorne-Putten, 1983*

4.4 ANALYSIS OF THE PHYSICAL SPACE

Besides the fact that facilities can change, the physical space can also be influenced by the ageing population and/or the shrinking of household sizes. In order to analyze this, the audit tools developed by Kan et al. (2020) were used, as described in section 3.2.4. Various components of this analysis reveal signs of an ageing population. At the same time, there are certain aspects in the public space that need to be adjusted to create a safer and more accommodating environment for older individuals. The photo analysis of the physical space is divided into two categories. Firstly, there are photos taken of playgrounds that provide clues about the presence of an older population. Additionally, there is a section that focuses on traffic safety and the ability of older people to move around effectively and safely. This includes considerations such as the accessibility of public transportation and the overall quality of the public space.

4.4.1 OUTDATED PLAYGROUNDS

According to Kan et al. (2020) their audit tools, outdated playgrounds are a great way to measure whether a neighbourhood ages or not. Older populations are often related towards outdated playgrounds that suffer from overdue maintenance. However, it should be noted that proper maintenance of playground equipment prevents this issue. The exact reason for municipalities to replace or not replace playground equipment is unclear. It is not evident whether age truly plays a role in the renewal of playgrounds. And it is also unclear whether neighbourhoods with a higher proportion of children receive faster investments in new playground equipment. Apart from that, the Dutch new town neighbourhoods find their origin in the 1970s and 1980s. Therefore, it is not surprising that the original playground equipment is outdated after nearly 50 years.

During the field research, four different new towns were visited: Duiven, Nieuwegein, Purmerend, and Almere. Duiven and Nieuwegein did not experience any significant population growth, while Purmerend and Almere had a substantial increase in population. Interestingly, in many instances, the playgrounds were not the oldest structures. They had been renovated a few years ago, which means they were not old but also not brand new. This was observed in figures 4.41*, 4.43, 4.45, and 4.46. It is worth noting that the two playgrounds that remained unchanged from the beginning were located in Duiven and Nieuwegein (figures 4.42 & 4.44). However, the small number of such instances does not allow for a definitive conclusion regarding the direct impact of population growth or age on the appearance of the playgrounds.

4.4.2 NEIGHBOURHOOD ACCESSIBILITY AND PHYSICAL SPACE

Physical space can reveal the demographic shift towards an ageing population, highlighting the importance of accessibility. Kan et al. (2020) have developed audit tools that offer various metrics to assess population ageing. By observing the presence of numerous adaptations within the physical environment, we can identify indicators of an ageing population. However, this also presents an opportunity to identify areas where enhancements can be made to improve accessibility. For instance, designing pedestrian crossings that accommodate the pace of individuals using mobility aids, such as walkers or rollators, can promote independent mobility. Installing handrails in public spaces provides additional support. Additionally, evaluating the ease of wheelchair access to sidewalks through ramps and curb cuts is crucial for enhancing mobility among individuals with mobility impairments. Kan et al. (2020) directly connects these adaptations with an older population.

Through photo analysis, it becomes evident that certain aspects display indications of an ageing population, while others do not. Figure 4.47 exemplifies a staircase in Purmerend leading to a bus stop, which is an inaccessible transit stop and unsuitable for accommodating the needs of an ageing population. This is particularly problematic as individuals tend to face increased mobility challenges as they grow older. Meanwhile, in another neighbourhood within Purmerend (as shown in Figure 4.48), the street design facilitates easy crossings for individuals walking at a slower pace. This is achieved through the presence of a wide median strip along the street, which enhances accessibility and promotes safe pedestrian movement.

*Figure 4.41 - 4.52 on p. 62-63

4. RESULTS

Almere-Haven, the oldest neighbourhood in the Almere new town, exhibits a significantly higher proportion of residents aged 65 and above compared to other areas in Almere. This demographic trend is evident in figure 4.49, which showcases a designated parking area specifically for scootmobiles. Scootmobiles are commonly utilized by elderly individuals in the Netherlands, further highlighting the neighbourhood's emphasis on catering to the needs and preferences of its ageing population. Simultaneously, certain findings do not directly indicate an ageing population, but shed light on the challenges that need to be addressed in an ageing neighbourhood. For instance, figure 4.50 depicts a set of stairs leading to a parking area, which poses difficulties for individuals with mobility issues. This highlights the necessity for improvements to make the location more accessible and accommodating for a larger population that faces challenges with stair usage. Similarly, the houses depicted in figure 4.52 present a comparable issue. These apartments lack an elevator and can only be accessed via a staircase, making it exceedingly difficult for individuals with disabilities to reside in such premises. The absence of adequate accessibility measures severely limits the livability of these spaces for those with mobility challenges.

Lastly, the general maintenance of public spaces can serve as an indicator of an ageing population. Many new towns experience a lack of upkeep in several aspects. For instance, the transformer stations in Purmerend, public facilities in Almere, and even benches for seating. Figure 4.51 exemplifies a bench in Purmerend showing signs of ageing, such as peeling paint and cracks in the wood, which are attributed to a lack of maintenance. These visible signs highlight the need for attention and investment in maintaining public amenities, reflecting the impact of an ageing population on the overall condition of the community.

However, while the literature suggests a potential direct link between accessibility and physical space to an older population, it is important to note that this conclusion cannot be made with absolute certainty. Just like the outdated playgrounds, neighbourhood accessibility and physical space are influenced by multiple variables beyond just age demographics. Other factors come into play, shaping the overall accessibility and condition of the community.

Figure 4.41: A spring rider at a playground in Purmerend. Spring rider looks old, but slide and climbing frames are newer.

Figure 4.42: A seesaw in Duiven. Playground consists of old equipment, and the sand and grass is not well maintained.

Figure 4.43: Playground in Purmerend. It is not outdated, but not new either.

Figure 4.44: Playground in Nieuwegein. The equipment was old, but well maintained.

Figure 4.45: Renovated playground in Duiven.

Figure 4.46: Playground in Almere. It is not outdated, but not new either.

Figure 4.47: Bus stop in Purmerend that is not accessible for persons with disabilities or people with mobility issues.

Figure 4.48: Pedestrian crossing in Purmerend that provides median strip to make it easier to cross the road. Especially helpful for people that walk at a slower pace.

Figure 4.49: Parking for scootmobiles in Almere-Haven. Provides parking space for people that can not use a bicycle or a car. Scootmobiles are often used by elderly in the Netherlands.

Figure 4.50: Parkingplace in Duiven that is only reachable by stairs. Makes it difficult or impossible to reach for persons with disabilities.

Figure 4.51: Bench in Purmerend that shows signs of ageing such as cracks in the wood, and a lack of paint.

Figure 4.52: Apartments in Nieuwegein that are only accessible through stairs. Makes it impossible for persons with disabilities to live here.

4.5 RESUME

4.5.1 MORE OR LESS FACILITIES?

Reflecting on the regression analyses, one lingering question remains unanswered: as a new town ages, does it necessitate an increase or decrease in the provision of specific facilities? Both ageing and household size influence facilities.

Elementary schools and childcare centres

In Dutch new towns, age is almost significant with a p-value of 0.07. However, in the Netherlands, it is significant. Together with the photo analysis, one can assume that an increase in the elderly population, and consequently a decrease in the number of children, results in reduced demand for primary education. At the same time, an increase in the 0 to 15-year-old age group demonstrates a greater demand for primary education in the Netherlands. These same findings can be linked to childcare centres, which are also influenced by the number of children and elderly individuals in a residential area. Therefore, ageing neighbourhoods require fewer primary schools and childcare centres. This calls for adjustments in the provision of schools and childcare centres, such as merging some facilities or repurposing vacant classrooms/entire school buildings for other functions.

High schools

Regarding secondary schools, a somewhat less clear correlation can be found, with some contradictions in the data analysis compared to the literature. Secondary schools vary greatly in the number of students. For example, Meergronden (comprising VMBO to VWO levels) in Almere-Haven has around 1200 students, while Oranje Nassau College (also VMBO to VWO) in Zoetermeer has around 1800 students (Scholenopdekaart.nl, 2023). The fluctuation in student numbers is not reflected in the regression because a decrease of a few hundred students is unlikely to result in the closure of a high school. At the same time, in some Dutch new towns, high schools are shared with nearby villages. This is the case, for instance, in Duiven, where Candea College also serves as the closest high school for children in Westervoort. Therefore, it is not clear whether ageing Dutch new towns can facilitate more or fewer secondary schools.

General practitioners

Regarding general practitioners, a correlation has been found between age and the number of general practitioners in growth centres. The more elderly individuals there are, the more general practitioners are needed, while the more young people there are, the fewer general practitioners are required. This means that as a Dutch new town ages, more general practitioners need to be facilitated. At the same time, existing facilities need to be renewed as they no longer meet current requirements.

Cafes and cafeterias

For cafés and cafeterias, the key demographic variable is household size. For both, it holds that as households become larger, there is less demand for cafés and cafeterias. This can work in two directions. On one hand, small households often consist of young individuals. However, the analysis also reveals that the age group of 15 to 25 has a negative influence on the number of cafés and cafeterias. This makes it plausible that small households consisting of elderly individuals have a greater need for more cafés and cafeterias. The regression also shows that the 65+ age group is the variable with the greatest influence on the number of cafeterias. Therefore, a Dutch new town will need to construct more of these facilities. The photo analysis also demonstrates that there is no decrease in these facilities and that they are also provided at the neighbourhood level, as seen in Purmerend (Figure 4.34 and 4.35).

Everyday food & drug stores (ef&d)

Ef&d stores consist of various forms of retail, such as greengrocers, bakeries, ethnic food stores, and drugstores. In Dutch new towns these daily groceries are partly influenced by age, where an older population results in slightly more of these types of stores. However, the address density, which is used to measure the degree of urbanization, plays by far the most significant role. This variable weighs 10 times more heavily in the Netherlands compared to the next largest demographic variable. This

demonstrates that the level of urbanization has the greatest influence on daily groceries. This means that this is less of an issue, when experiencing an ageing new town.

4.5.2 NEIGHBOURHOOD OR CITY LEVEL

Certain facilities, like elementary schools and childcare centres, are primarily determined at the neighbourhood level, catering to the needs of the local community. This results in shorter travel distances for residents. On the other hand, secondary education institutions and retail are influenced by city-level considerations, requiring individuals to travel longer distances using various modes of transportation. This means that if there is significant ageing within a specific neighbourhood, it can lead to localized changes in terms of facilities on neighbourhood scale. This can also be seen through new construction. Construction at the neighbourhood level has more impact on facilities compared to large-scale city-level development.

4.5.3 RETAIL AND DEGREE OF URBANITY

When considering retail, the connection between the level of urbanization and the supply and vacancy rates becomes apparent. At a certain degree of urbanisation, there is no longer a negative impact on retail. However, it is important to note that essential daily necessities like bakeries and medicine are an exception to this trend. These items remain consistently accessible, even in areas with lower levels of urbanity. After all, people will always require the ability to purchase groceries and have access to a nearby pharmacy for their basic needs.

4.5.5 RENOVATED FACILITIES AND PHYSICAL SPACE

For all facilities, there is an ongoing process of gradual transition, as the original buildings from the 1980s are giving way to new constructions. This transformation is driven by the fact that these facilities have aged over time and are now in need of rejuvenation. It is important to note that this process of renewal and revitalization is separate from the changing demographics within specific neighbourhoods. While demographic shifts may influence the demand and utilization of facilities, the need for rejuvenation and updating arises regardless of these demographic changes. Therefore, even in areas where there might not be significant changes in population age or composition, the evolution and modernization of facilities remain a continuous and separate aspect of urban development.

Figure 4.53: Renovation of the city centre and housing development in Nieuwegein.

Source: Own research, 2023

5. CONCLUSION

5. CONCLUSION

This master's thesis has provided a comprehensive exploration of demographics and facilities in Dutch new towns through the investigation of the main research question and its associated sub-questions. Throughout this study, an in-depth analysis of quantitative data and field observations has been conducted, shedding light on the intricate dynamics between ageing, households, facilities, and built environment. By addressing each sub-question in turn and subsequently answering the main research question, valuable insights and findings have been obtained, contributing to the existing body of knowledge in the spatial planning field.

Turning the attention to the first sub-question, which examines the household demographics, age and population, I sought to investigate *how the different Dutch new towns developed in household demographics, age and population, and what the main factors are of that change.* The population dynamics in new towns exhibit a remarkable range of variation, both in terms of population size and growth rates. One of the main factors are **diverse governmental growth strategies**, including VINEX expansions and local urban expansion plans. New towns with significant expansions, like Houten, witnessed a substantial population growth of 64%, whereas Huizen experienced a decline of -2% in absolute population size. These trends are often reflected in the population pyramids, where **new towns with recent urban expansions tend to have a larger proportion of citizens under the age of eighteen.**

Another significant aspect observed in the new towns is the decrease in household size, which exhibits a similar pattern across the different locations. All the new towns experienced a decrease in household size of at least 26%, with peaks reaching -34% in Nieuwegein. In contrast, the nationwide household size decrease in the Netherlands was only -13% between 1995 and 2022. A main factor of this are the **changing living arrangements of former families, where parents remain in their single-family homes while their children have moved away.** Consequently, the average household size in the new towns decreased by -29% on average, from approximately 3,1 to 2,1 persons per household. This finding aligns with the policy formulated in the early 1970s, which reflected the prevailing living preferences centered around single-family homes. As a consequence, a lot of these homes were constructed within the new towns, leading to **a homogenous population composition**. It highlights the intricate interplay between population dynamics, forms of housing, urban growth strategies, and shifting household compositions within the new towns.

Figure 5.1: Nieuwegein Zuilenstein

Source: Own research, 2023

5. CONCLUSION

The second sub-question examines the spatial effects of this change. I sought to investigate *what the effect of this changing makeup of household demographics, and age is on facilities.* The findings underscore the intricate **relationship between facilities and demographics** within Dutch new towns, although **the extent and nature of this influence vary across different types of facilities.** First, the educational facilities. Elementary schools and childcare centres are notably affected by age, with a higher proportion of younger individuals necessitating an increase in these facilities. High schools, on the other hand, do not exhibit a direct correlation with age in Dutch new towns. However, the data does reveal a negative relationship with households having children, a peculiar outcome that will be further explored in the discussion. Notably, the photo analysis provides some indications of the association between age and school facilities, as evidenced by the closure of a high school in Nieuwegein.

Moving on to healthcare facilities, the data analysis focused on general practices. It demonstrates that an ageing population corresponds to a higher demand for general practices, while an increase in the number of children is associated with fewer general practices. These findings suggest that as new towns age, the need for additional general practices becomes apparent. Additionally, the photo analysis highlights the presence of outdated healthcare facilities, emphasizing the importance of renovations in addressing the challenges faced by new towns in this aspect.

Shifting our focus to retail and leisure facilities, both cafeterias and cafes exhibit a negative correlation with household size in Dutch new towns. This implies that as households become smaller, the number of cafes and cafeterias tends to increase. This observation may be attributed to the concentration of cafes in city centres, where housing units often consist of apartments with fewer rooms, resulting in smaller household sizes. Concurrently, it was found that a larger elderly population nationwide leads to a higher presence of cafeterias, suggesting that an ageing new town may require an increased number of these establishments. Furthermore, everyday food and drug stores follow a similar trend, with a larger elderly population leading to more of these stores, while a higher concentration of young residents corresponds to fewer such stores. The photo analysis further revealed challenges faced by new towns, including vacant storefronts in regular retail establishments such as clothing stores. It appears that people are willing to travel further for non-daily amenities. This makes that there is a difference between the

Figure 5.2: Almere Haven

Source: Own research, 2023

daily amenities and the non-daily amenities. Non-daily amenities are more prone to shifts in demographics. In terms of leisure amenities, the availability of parks was intentionally incorporated into the initial planning stages of all Dutch new towns, reflecting their significance as communal spaces for residents.

The third sub-question researches *how the changing makeup of households and age demographics affect the spatial and physical conception of new towns.* First, the examination of outdated playgrounds in Dutch new towns provides insights into the relationship between demographics and neighbourhood appearance. **Older populations are often associated with outdated playgrounds** suffering from overdue maintenance, though proper upkeep can alleviate this issue. The factors influencing the replacement of playground equipment and the investment in new equipment for neighbourhoods with more children remain unclear. Given the origins of Dutch new towns in the 1970s and 1980s, it is not surprising that the original playground equipment is outdated after nearly five decades. However, the age of the playgrounds does not always align with the age of other structures in the neighbourhoods, as some playgrounds have been recently renovated. The small number of such instances does not allow for a definitive conclusion regarding the direct impact of population growth or age on the appearance of the playgrounds.

Regarding neighbourhood accessibility and physical space, **adaptations within the physical environment serve as indicators of an ageing population** and opportunities for enhancing accessibility. Certain elements, such as staircase designs leading to transit stops, pose challenges for individuals with mobility impairments, while features like wide median strips facilitate safe pedestrian movement. **Neighbourhoods with a higher proportion of elderly residents exhibit amenities tailored to their needs**, such as designated parking areas for scoot mobiles. Nevertheless, there are still challenges, such as stairs leading to parking areas and apartments lacking elevators, which call for improved accessibility in ageing communities. The maintenance of public spaces, including transformer stations, public facilities, and benches, reveals signs of ageing and neglect. This highlights the importance of investing in the upkeep of public amenities, reflecting the impact of an ageing population on the overall condition of the community.

It is important to acknowledge that while t**here is a potential link between accessibility, physical space, and an older population**, definitive conclusions can-

Figure 5.3: Purmerend Purmer-Noord

Source: Own research, 2023

not be drawn. Neighbourhood accessibility and condition are influenced by multiple variables beyond age demographics. Therefore, further research and analysis are necessary to gain a more comprehensive understanding of the interplay between demographics and the state of physical space in Dutch new towns.

After the three sub-questions the research question can be answered: ***What are the changes in the demographic makeup of households in Dutch new towns, such as age and household composition, and how do these changes affect the built environment of these areas?*** It can be concluded that Dutch new towns have experienced changes in the demographic composition of households, including shifts in age demographics and household sizes. The prevalence of single-family homes, which was a result of past housing policies, contributed to a homogenous population within these areas. Households are getting relatively smaller compared to the Dutch average. At the same time, the older age groups are growing. Children have moved away meanwhile their parents still live in the houses in new towns.

These demographic changes have had implications for the built environment of Dutch new towns. For instance, the demand for educational facilities, such as elementary schools and childcare centres, is influenced by the proportion of younger individuals in the population. As the population ages, there is a higher demand for healthcare facilities, particularly general practices. Retail and leisure facilities also reflect changes in household size and age demographics. Cafes and cafeterias tend to increase as households become smaller, while the presence of everyday food and drug stores is influenced by the age distribution of the population. The availability and condition of parks and playgrounds also reflect the demographic makeup of the population, with outdated playgrounds often associated with ageing populations.

Furthermore, the accessibility and physical space within Dutch new towns show signs of adaptation to accommodate an ageing population, but there are still challenges in terms of mobility and overall maintenance.

Figure 5.4: Almere Parkwijk

Source: Own research, 2023

6.
DISCUSSION

The following discussion delves into the interplay between urbanity, neighbourhoods, facilities, policy, and life cycles in Dutch new towns. By examining various aspects from the result section it aims to shed light on the complexities and potential implications for urban planning strategies.

6.1 URBANITY AND RETAIL

In exploring the dynamics of urbanity and its impact on neighbourhoods, it is evident that a correlation exists between the degree of urbanity and the availability of facilities within a given area. Particularly, as urban areas densify, there is a noticeable effect on the plenitude of facilities, especially when considering non-daily needs in retail. Notably, there seems to be a threshold of urbanity where retail establishments experience less negative repercussions from shifts in demographics. Indicating that areas that have a higher degree of urbanity, are better equipped to mitigate the negative impacts of demographic changes. A higher degree of urbanity provides a larger critical mass of potential customers, thereby reducing the negative effects of demographic shifts on these facilities. Nevertheless, further investigation is required to fully comprehend this phenomenon and its implications.

Simultaneously, it is conceivable that specific new towns have attained the minimum requisite level of facilities necessary to sustain a small community. Essential establishments such as schools, general practices, and retail stores catering to daily needs should be present, regardless of demographic changes or population decline. These fundamental facilities are likely to persist perpetually. Further investigation could identify the primary factors that determine the threshold between having sufficient urbanity and customers to sustain non-daily needs, and the minimum required level of facilities.

6.2 SINGLE-FAMILY HOMES AND HOMOGENEOUS DEMOGRAPHICS

Regarding the policy framework that underpins the development of new towns, there has been a strong emphasis on constructing single-family homes, primarily due to their alignment with the prevailing residential preferences among the Dutch population (as evidenced in table 4.1). However, contemporary observations reveal that this approach to neighbourhood development can have adverse consequences for the community. The resulting demographic composition becomes highly homogeneous, comprising primarily of former single-family households. Consequently, the demographic decline in such areas is considerably more pronounced compared to neighbourhoods featuring a greater mix of apartments and housing options. For further research, it is interesting to investigate whether there are practices where incremental interventions in the physical living environment have resulted in a better mix or heterogeneity in housing types, and whether this has proven effective.

6.3 FACILITIES AND THE ADJACENT CITY

Although this study chose to investigate the impacts of demographic changes rather than those of adjacent cities, notable correlations were identified. Significant findings have emerged concerning the relationship between facilities and connectivity to train stations and neighboring cities. The influence of adjacent urban centres on the provision of facilities within Dutch new towns needs further research. By delving deeper into this aspect, a more comprehensive understanding of the interplay between neighbouring cities and the availability of amenities in new towns can be achieved, ultimately contributing to more informed policy decisions and urban planning strategies.

6.4 HIGH SCHOOLS ON THE OUTSKIRTS

The regression analyses performed on high schools reveal unexpected and contradictory correlations. One such example is the negative association between the proportion of children aged 0 to 15 years and the quantity of high schools in a given area. One possible explanation for this phenomenon is that high schools are often situated on the outskirts of towns and cities. Consequently, areas with smaller populations, encompassing both young and old residents, tend to have a higher presence of high schools. This scenario is more common on the periphery of Dutch new towns and other villages throughout the Netherlands. These findings offer a potential explanation for the conflicting results observed in the regressions concerning secondary education.

6.5 INFLUENCE OF 60S, 70S AND 80S POLICY

The policy formulated for the development of Dutch new towns encompassed several key principles that continue to exert certain effects to this day. Firstly, there was an emphasis on homogeneous housing provision, as highlighted in paragraph 6.2. Additionally, new town policy served as a starting point and a source of inspiration for subsequent VINEX expansions. The new towns served as experimental sites, offering valuable insights into what approaches worked and what did not. For instance, the emphasis on active transportation in the new town Houten influenced the planning of Houten VINEX. Simultaneously, VINEX adhered to similar core principles, promoting low-rise residential development on the peripheries of cities. Many of the initial new towns were incorporated into the VINEX expansions. This approach aimed to minimize commuting times while ensuring that the primary urban centres remained the primary destination. The intention was to avoid replicating the “donut model” prevalent in American cities, where the core city decays while suburban areas thrive. This was basically the same as in the policy from the 1970s and 1980s.

6.6 RENEWED NEIGHBOURHOOD LIFE-CYCLES

Taking the characteristics of Dutch new towns into consideration, the life cycle of these neighbourhoods can be made case specific. This is useful, because they all consist of the same historic background, and are made in the Dutch institutional context. This makes it easier to make a generalizable framework that can be applied to all the Dutch new towns, or other neighbourhoods that face the same challenges. In table 6.1 this new framework is shown. Making a new framework helps with understanding the life cycle of a neighbourhood and therefore can predict future changes and helps with planning for future development. This revised framework considers the unique challenges and opportunities of the former new towns and recognizes the need for targeted and proactive interventions to support the continued growth and development of these communities. It uses things from this discussion and places an emphasis on the importance of inclusive and sustainable development and recognizes the need for a mix of housing options, high-quality public spaces and services, and economic opportunities to support thriving communities. The future evolution of current new towns poses an intriguing question: What will be the trajectory of these neighbourhoods once the current population has passed away? This aspect presents an opportunity for further research and investigation.

Table 6.1: Renewed neighbourhood life-cycles

Stage 1: Emerging	A growing, dynamic, and diverse community with a mix of new and established residents, and a range of housing options, services, and infrastructure.
Stage 2: Consolidating	As the town grows and matures, it reaches a plateau where growth and development slow down. Town may experience some challenges related to pressure on infrastructure and public services, as well as accommodating a growing and changing population.
Stage 3: Ageing	A shift in demographics as the originally single-family homes become occupied by ageing couples whose children have moved away. A decline in economic activity, as the ageing population tends to have lower levels of income and spending. The needs for facilities changes.
Stage 4: Renewal	To address the challenges of ageing infrastructure and a declining economy, the town undergoes a process of renewal and revitalization. This may involve investment in new infrastructure and public services, the development of housing options more suitable for ageing residents.
Stage 5: Balance and Sustainability	A balanced and sustainable community. The town has adapted to the changing demographics and economic conditions and has become an attractive place to live for both young families and older residents. The town has a mix of housing options, high-quality public spaces, services, and a strong sense of community. The town has also put in place measures to ensure the sustainability of its infrastructure, services, and environment for future generations.

7. RECOMMENDATIONS

Based on the insights gained from this study, several recommendations emerge that can contribute to more effective urban planning and neighbourhood development strategies in Dutch new towns or other residential developments. These recommendations aim to address key issues identified in the research and provide guidance for policymakers and planners. By implementing the following suggestions, it is possible to foster sustainable and inclusive communities while maximizing the provision of essential facilities.

7.1 NEW CONSTRUCTION ON NEIGHBOURHOOD LEVEL

As seen in paragraph 4.5.2, there is a difference between facilities on the city level and neighbourhood level. Urban renewal at the neighbourhood level has the potential to significantly impact the preservation of local facilities. In contrast, the development of large new locations adjacent to established towns often has minimal effects on the older neighbourhoods. A striking example of this can be seen in Purmerend, where the construction of the Weidevenne neighbourhood in the southwest did not contribute to the improvement or increased liveability of the pre-existing neighbourhoods. This lack of impact stems from the fact that Weidevenne possesses its own set of new facilities, rendering it largely self-sufficient. However, a different approach was taken in Duiven, where new construction was carried out in smaller, incremental batches. This approach has proven beneficial in multiple ways. Firstly, it enables the better utilization of existing facilities, ensuring that they remain relevant and well-utilized. Moreover, the introduction of newer facilities accompanying the construction of new houses in Duiven has had a positive spillover effect on the older neighbourhoods. This symbiotic relationship between the old and new neighbourhoods is contingent upon the establishment of strong connections and interactions.

To illustrate these examples, Figure 6.4 and 6.5 showcase both new towns, with blue circles denoting the locations where new construction occurred subsequent to their initial development. For neighbourhoods constructed within a specific time frame, it is highly recommended to prioritize incremental new construction as opposed to large-scale residential development adjacent to the neighbourhood. This approach ensures a more positive influence on local facilities and amenities. By implementing incremental construction, the existing neighbourhood infrastructure and resources can be effectively utilized and enhanced, resulting in a more cohesive and well-rounded community. In contrast, large-scale developments on the outskirts of a neighbourhood may have limited impact on the existing facilities and may create a disconnected environment.

7.2 SMALL-SCALE MIX OF FUNCTIONS

To enhance the liveability of neighbourhoods and create environments that function for older populations, it is advisable to promote multi-functionality within the neighbourhood. By facilitating diverse facilities within close proximity, accessibility for older individuals can be improved while simultaneously meeting the community's specific facility needs. Dutch new towns often feature architectural designs that allow for in-house services without disrupting the privacy of residents, often providing separate entrances (figure 6.1, 6.2 and 6.3). It is recommended that municipalities make use of these opportunities and demonstrate flexibility in adapting zoning plans to accommodate the integration of desired functions within residential properties.

Simultaneously, it is crucial to demonstrate flexibility in repurposing underutilized facilities that are no longer in high demand. This research has revealed instances where certain buildings, such as the Anna van Rijn high school in Nieuwegein, remain vacant due to changing needs. However, it is important to recognize the growing need for other facilities, such as additional general practices and community spaces. Repurposing these existing structures represents a more sustainable approach, avoiding unnecessary demolitions or leaving spaces empty. By adapting and repurposing these underutilized facilities, valuable resources can be conserved while meeting the evolving needs of the community.

7.3 THINGS TO REPEAT

The centralization of spatial planning in the timeframe of Dutch new towns has brought several advantages. It allows for targeted and precise planning, enabling the implementation of desirable urban design ideas on a national scale. This centralization also facilitates a faster and more efficient process of constructing new housing units.

Furthermore, the successful integration and emphasis on green spaces within the built environment have proven to be highly beneficial. Parks seamlessly woven into the urban fabric enhance the overall quality of life. Moreover, the deliberate focus on establishing well-connected cycling infrastructure in certain new towns, exemplified by Houten and Duiven, has effectively promoted cycling as a widely utilised mode of transportation. Considering the ongoing transition towards sustainable mobility, it is imperative to maintain this mindset and ensure that active transportation and the principles of Transit-Oriented Development are integrated into the planning and design of new residential neighbourhoods.

Figure 6.1: Hairsalon at home in N'gein

Source: Own research, 2023

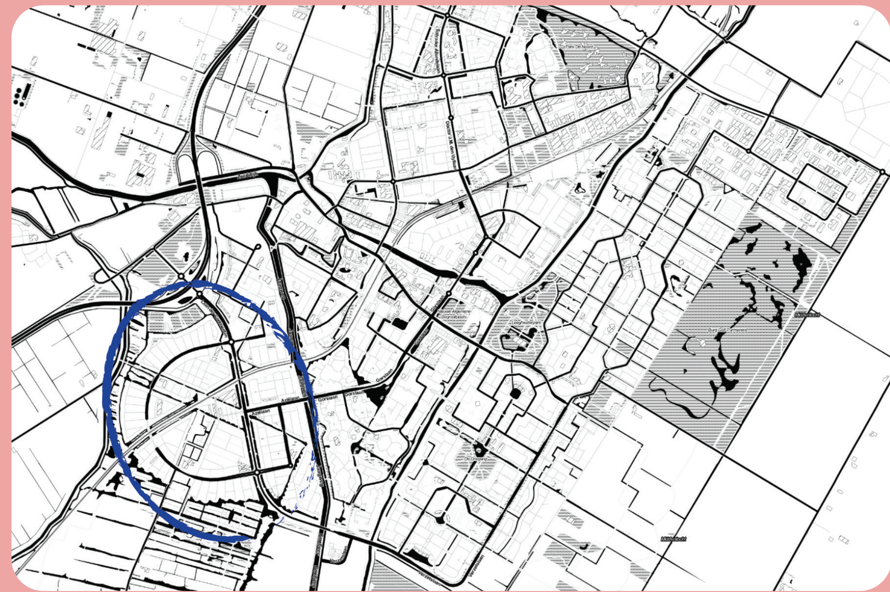
Figure 6.2: typical new town architecture with potential for services at-home

Source: Own research, 2023

Figure 6.3: Garages as potential for services at-home

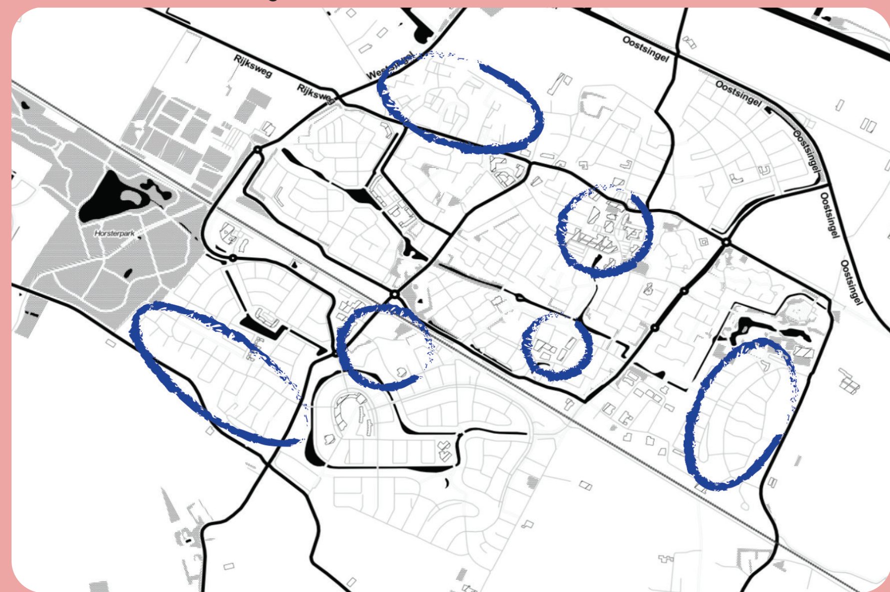
Source: Own research, 2023

Figure 6.4: New construction in Purmerend



Source: Maps.stamen, 2023

Figure 6.5: New construction in Duiven



Source: Maps.stamen, 2023

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9.
APPENDIX

APPENDIX 1. REGRESSION ON ELEMENTARY SCHOOLS IN NEW TOWNS

1 outlier removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Basis onderwijs, aantal binnen 3 km	161	.00000000000	23.000000000	11.204968944	4.8684417584	23.702
Sum of OAD	161	50	3994	1759.75	779.012	606859.600
Sum of tot 15 jaar	161	0	5890	1255.78	883.893	781266.112
Sum of 65 jaar en ouder	161	0	3360	1212.05	757.043	573113.898
Bevolkingsgroei	161	-530	2915	170.34	530.224	281137.539
Sum of Aandeel met kinderen	154	13.586097946	59.012875536	37.531301952	8.0484853440	64.778
Valid N (listwise)	154					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.648[a]	.419	.400	3.6330734678	1.143

a. Predictors: (Constant), Sum of Aandeel met kinderen, Bevolkingsgroei, Sum of 65 jaar en ouder, Sum of OAD, Sum of tot 15 jaar

b. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1411.625	5	282.325	21.390	<.001[b]
	Residual	1953.485	148	13.199		
	Total	3365.110	153			

a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

b. Predictors: (Constant), Sum of Aandeel met kinderen, Bevolkingsgroei, Sum of 65 jaar en ouder, Sum of OAD, Sum of tot 15 jaar

Coefficients[a]

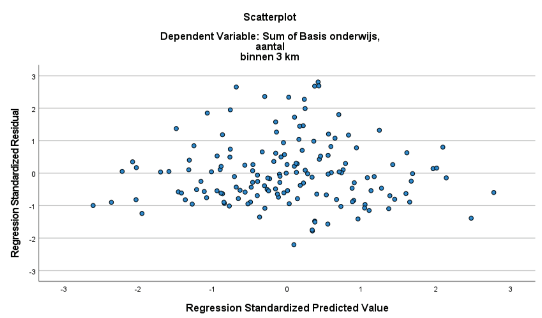
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.344	2.586		.133	.894		
	Sum of OAD	.005	.000	.731	9.500	<.001	.663	1.508
	Sum of tot 15 jaar	.001	.001	.097	.867	.387	.312	3.202
	Sum of 65 jaar en ouder	-.001	.001	-.178	-1.838	.068	.419	2.384
	Bevolkingsgroei	.000	.001	.017	.263	.793	.929	1.076
	Sum of Aandeel met kinderen	.087	.058	.149	1.492	.138	.393	2.543

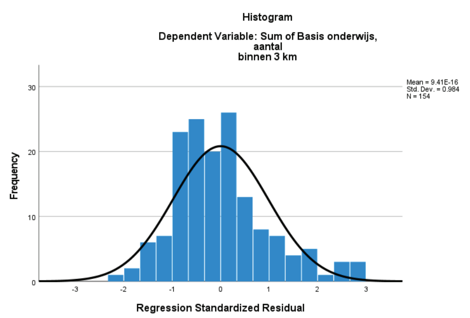
a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

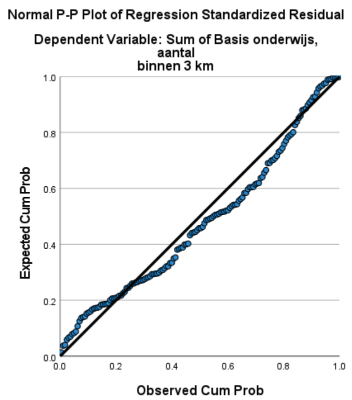
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.6190483570	19.964372635	11.531168831	3.0374841368	154
Residual	-8.010636330	10.202452660	.00000000000	3.5732164322	154
Std. Predicted Value	-2.605	2.776	.000	1.000	154
Std. Residual	-2.205	2.808	.000	.984	154

a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km







9. APPENDIX

APPENDIX 2. REGRESSION ON ELEMENTARY SCHOOLS IN THE NETHERLANDS

219 outliers removed, 522 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Basis onderwijs, aantal binnen 3 km	3135	.0	44.9	5.804	5.7845	33.461
Sum of OAD	3135	15	7890	937.14	1059.285	1122083.820
Sum of tot 15 jaar	3135	10	6095	730.14	716.380	513200.293
Sum of 65 jaar en ouder	3135	5	5210	878.21	809.161	654741.505
Sum of Bevolkingsontwikkeling	3135	-4160	4225	100.96	330.721	109376.486
Sum of Aandeel met kinderen	3135	2.2222222222	70.822281167	35.976274151	8.2591988877	68.214
Valid N (listwise)	3135					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.956[a]	.915	.914	1.6926	1.373

a. Predictors: (Constant), Sum of Aandeel met kinderen, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

b. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	95902.516	5	19180.503	6695.290	.000[b]
	Residual	8963.883	3129	2.865		
	Total	104866.399	3134			

a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

b. Predictors: (Constant), Sum of Aandeel met kinderen, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

Coefficients[a]

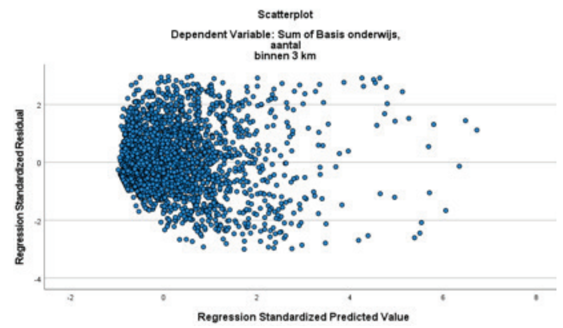
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	-.267	.199		-1.343	.179		
	Sum of OAD	.005	.000	.995	132.456	.000	.484	2.067
	Sum of tot 15 jaar	.000	.000	.041	3.704	<.001	.219	4.574
	Sum of 65 jaar en ouder	-.001	.000	-.093	-9.329	<.001	.274	3.655
	Sum of Bevolkingsontwikkeling	.000	.000	.014	2.528	.012	.930	1.075
	Sum of Aandeel met kinderen	.036	.005	.051	7.173	<.001	.532	1.878

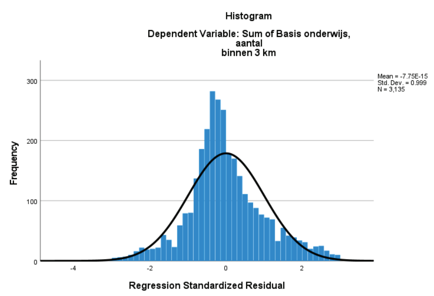
a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km

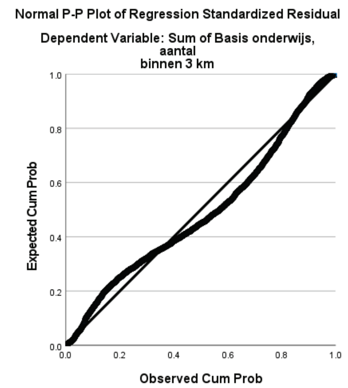
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.432	43.011	5.804	5.5318	3135
Residual	-5.0797	5.0554	.0000	1.6912	3135
Std. Predicted Value	-.971	6.726	.000	1.000	3135
Std. Residual	-3.001	2.987	.000	.999	3135

a. Dependent Variable: Sum of Basis onderwijs, aantal binnen 3 km







APPENDIX 3. REGRESSION ON HIGH SCHOOLS IN NEW TOWNS

1 outlier removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Voortgezet onderwijs, aantal binnen 3 km	157	.0	10.9	3.276	2.3040	5.309
Sum of OAD	157	50	3994	1820.15	727.543	529319.510
Sum of tot 15 jaar	157	20	5890	1295.80	864.177	746802.407
Sum of 65 jaar en ouder	157	20	3360	1251.15	732.890	537127.523
Sum of Aandeel met kinderen	157	3.6585365854	59.090909091	37.350238603	8.6835824105	75.405
Sum of Bevolkingsontwikkeling	157	-530	3040	200.29	582.856	339721.552
Valid N (listwise)	157					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.665[a]	.442	.424	1.7490	.978

a. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder, Sum of Aandeel met kinderen

b. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	366.250	5	73.250	23.947	<.001[b]
	Residual	461.892	151	3.059		
	Total	828.143	156			

a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

b. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder, Sum of Aandeel met kinderen

Coefficients[a]

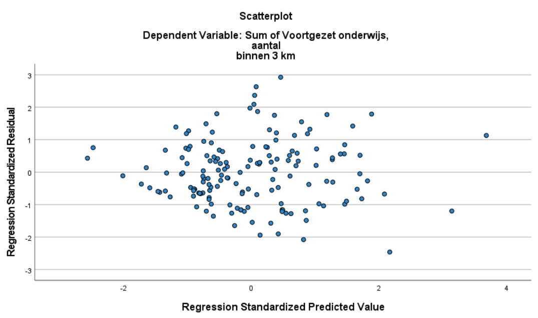
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.655	1.124		2.363	.019		
	Sum of OAD	.002	.000	.561	7.484	<.001	.657	1.523
	Sum of tot 15 jaar	.000	.000	.060	.572	.568	.336	2.972
	Sum of 65 jaar en ouder	.000	.000	-.091	-.994	.322	.439	2.278
	Sum of Aandeel met kinderen	-.069	.025	-.260	-2.796	.006	.428	2.335
	Sum of Bevolkingsontwikkeling	.001	.000	.139	2.198	.029	.923	1.083

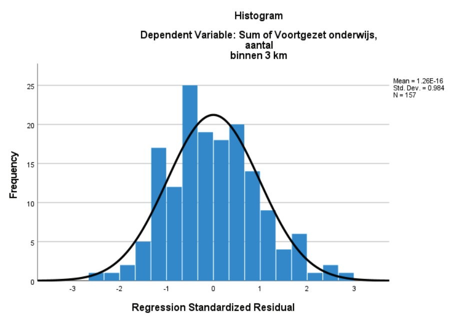
a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

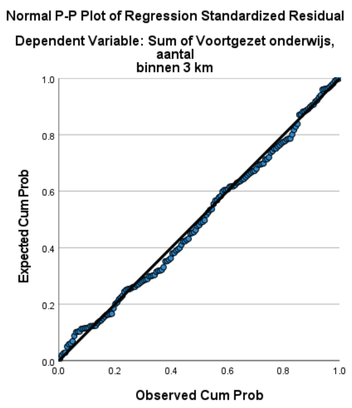
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.653	8.923	3.276	1.5322	157
Residual	-4.3039	5.1148	.0000	1.7207	157
Std. Predicted Value	-2.564	3.685	.000	1.000	157
Std. Residual	-2.461	2.924	.000	.984	157

a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km







APPENDIX 4. REGRESSION ON HIGH SCHOOLS IN THE NETHERLANDS

76 outliers removed, 522 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Voortgezet onderwijs, aantal binnen 3 km	3060	.0	26.4	1.680	2.7324	7.466
Sum of OAD	3060	15	11035	949.60	1165.656	1358754.298
Sum of tot 15 jaar	3060	10	6095	725.00	714.694	510787.251
Sum of 65 jaar en ouder	3060	5	5210	867.01	807.096	651404.397
Sum of Bevolkingsontwikkeling	3060	-4160	4225	98.70	335.294	112422.307
Sum of Aandeel met kinderen	3060	2.2222222222	70.822281167	36.087143583	8.2923772782	68.764
Valid N (listwise)	3060					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.912[a]	.831	.831	1.1243	1.153

a. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of Aandeel met kinderen, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

b. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18978.381	5	3795.676	3003.028	.000[b]
	Residual	3860.103	3054	1.264		
	Total	22838.484	3059			

a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

b. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of Aandeel met kinderen, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

Coefficients[a]

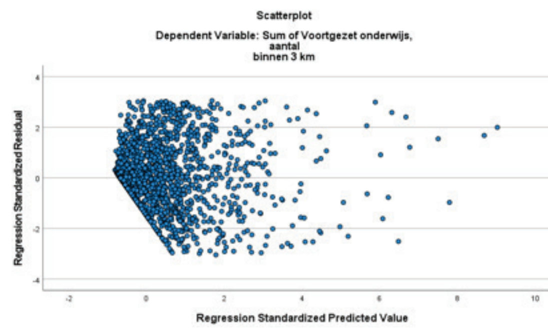
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.173	.132		1.310	.190		
	Sum of OAD	.002	.000	.956	91.661	.000	.508	1.967
	Sum of tot 15 jaar	.000	.000	-.082	-5.236	<.001	.224	4.471
	Sum of 65 jaar en ouder	.000	.000	-.039	-2.737	.006	.276	3.621
	Sum of Aandeel met kinderen	-.008	.003	-.024	-2.356	.019	.539	1.856
	Sum of Bevolkingsontwikkeling	4.366E-5	.000	.005	.699	.485	.942	1.062

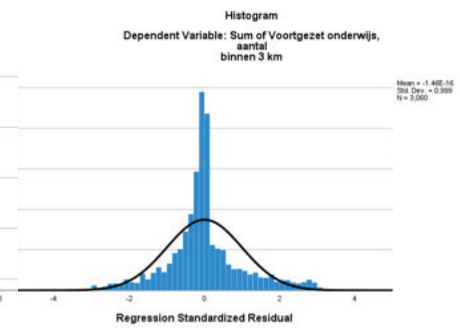
a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km

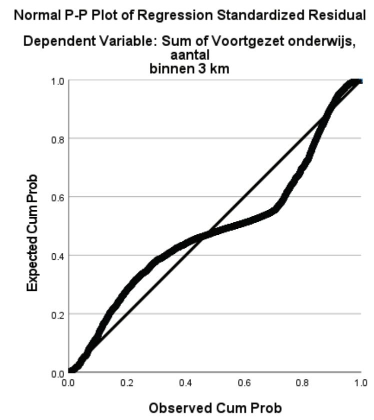
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.348	24.159	1.680	2.4908	3060
Residual	-3.4205	3.4281	.0000	1.1233	3060
Std. Predicted Value	-.814	9.025	.000	1.000	3060
Std. Residual	-3.042	3.049	.000	.999	3060

a. Dependent Variable: Sum of Voortgezet onderwijs, aantal binnen 3 km







APPENDIX 5. REGRESSION ON CHILDCARE CENTRES IN NEW TOWNS

1 outlier removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Kinderdagverblijf, aantal binnen 1 km	157	.0	7.2	2.775	1.5835	2.508
Sum of OAD	157	50	3994	1824.08	728.469	530667.327
Sum of tot 15 jaar	157	20	5890	1288.22	862.118	743247.760
Sum of 65 jaar en ouder	157	20	3360	1252.71	732.559	536642.465
Sum of Aandeel met kinderen	157	3.6585365854	59.090909091	37.246512850	8.6317015253	74.506
Sum of Bevolkingsontwikkeling	157	-530	3040	200.35	582.821	339680.485
Valid N (listwise)	157					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.532[a]	.283	.260	1.3626	1.560

a. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder, Sum of Aandeel met kinderen

b. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	110.839	5	22.168	11.940	<.001[b]
	Residual	280.339	151	1.857		
	Total	391.178	156			

a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

b. Predictors: (Constant), Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder, Sum of Aandeel met kinderen

Coefficients[a]

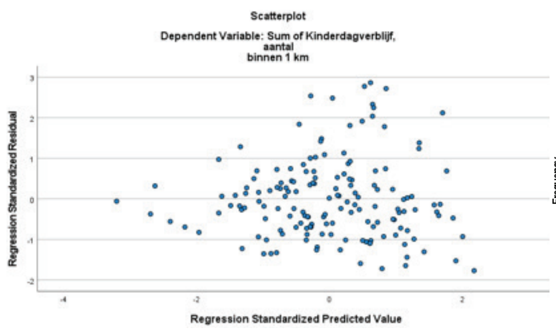
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.229	.876		.262	.794		
	Sum of OAD	.001	.000	.475	5.582	<.001	.656	1.525
	Sum of tot 15 jaar	.001	.000	.299	2.518	.013	.337	2.964
	Sum of 65 jaar en ouder	-.001	.000	-.332	-3.192	.002	.438	2.285
	Sum of Aandeel met kinderen	.025	.019	.139	1.322	.188	.432	2.313
	Sum of Bevolkingsontwikkeling	.000	.000	-.167	-2.328	.021	.922	1.085

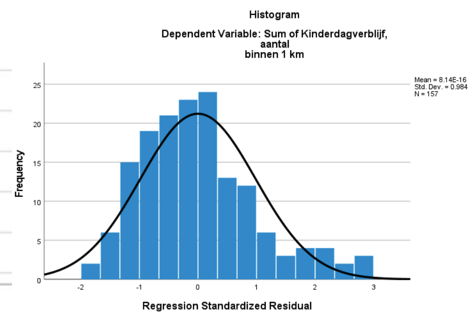
a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

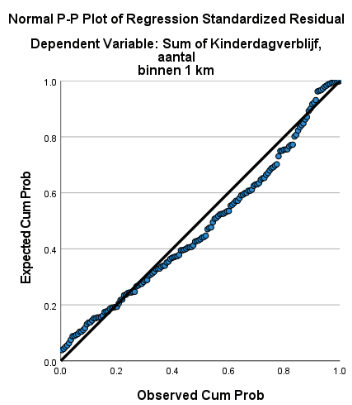
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.079	4.610	2.775	.8429	157
Residual	-2.4099	3.9022	.0000	1.3405	157
Std. Predicted Value	-3.197	2.177	.000	1.000	157
Std. Residual	-1.769	2.864	.000	.984	157

a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km







APPENDIX 6. REGRESSION ON CHILDCARE CENTRES IN THE NETHERLANDS

56 outliers removed, 522 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Kinderdagverblijf, aantal binnen 1 km	3162	.0	12.0	1.719	1.5432	2.381
Sum of OAD	3162	15	7743	915.21	984.663	969560.452
Sum of tot 15 jaar	3162	10	6095	721.81	702.373	493327.623
Sum of 65 jaar en ouder	3162	5	5210	883.23	814.652	663657.634
Sum of Bevolkingsontwikkeling	3162	-4160	4225	102.35	334.182	111677.709
Sum of Aandeel met kinderen	3162	2.2222222222	70.822281167	35.935816166	8.1810962572	66.930
Valid N (listwise)	3162					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.842[a]	.709	.709	.8331	1.677

a. Predictors: (Constant), Sum of Aandeel met kinderen, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

b. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5336.812	5	1067.362	1537.739	.000[b]
	Residual	2190.616	3156	.694		
	Total	7527.428	3161			

a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

b. Predictors: (Constant), Sum of Aandeel met kinderen, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

Coefficients[a]

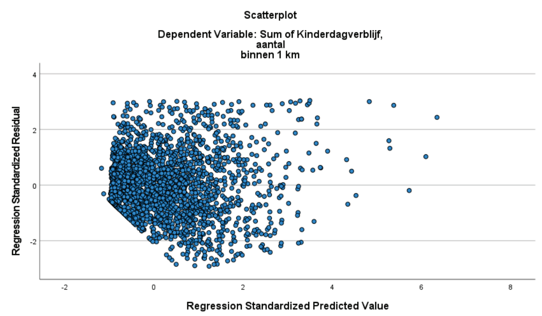
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.531	.099		5.386	<.001		
	Sum of OAD	.001	.000	.755	54.403	.000	.479	2.088
	Sum of tot 15 jaar	.000	.000	.223	10.617	<.001	.209	4.784
	Sum of 65 jaar en ouder	.000	.000	-.082	-4.318	<.001	.255	3.927
	Sum of Bevolkingsontwikkeling	.000	.000	-.046	-4.631	<.001	.922	1.085
	Sum of Aandeel met kinderen	-.002	.002	-.013	-.996	.319	.528	1.895

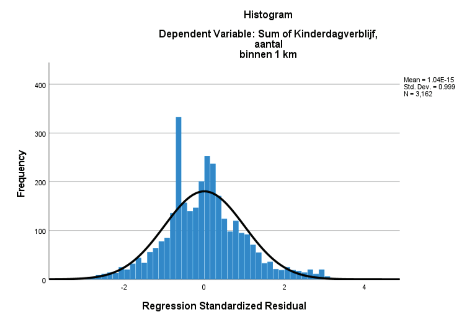
a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km

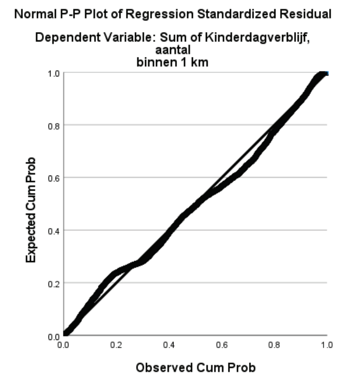
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.197	9.972	1.719	1.2994	3162
Residual	-2.4311	2.5323	.0000	.8325	3162
Std. Predicted Value	-1.172	6.352	.000	1.000	3162
Std. Residual	-2.918	3.039	.000	.999	3162

a. Dependent Variable: Sum of Kinderdagverblijf, aantal binnen 1 km







APPENDIX 7. REGRESSION ON GENERAL PRACTICES IN NEW TOWNS

0 outliers removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Huisartspraktijk, aantal binnen 3 km	167	.0	19.2	7.489	4.1867	17.528
Sum of OAD	167	18	3994	1735.49	797.518	636035.360
Sum of tot 15 jaar	167	0	5890	1224.82	886.508	785896.654
Sum of 65 jaar en ouder	167	0	3360	1184.58	763.280	582596.811
Sum of Bevolkingsontwikkeling	167	-530	3040	190.15	567.763	322354.345
Sum of Huishoudgrootte	167	.0	3.1	2.223	.3213	.103
Valid N (listwise)	167					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.808[a]	.653	.642	2.5043	1.072

a. Predictors: (Constant), Sum of Huishoudgrootte, Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of tot 15 jaar

b. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1899.985	5	379.997	60.590	<.001[b]
	Residual	1009.736	161	6.272		
	Total	2909.721	166			

a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

b. Predictors: (Constant), Sum of Huishoudgrootte, Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of tot 15 jaar

Coefficients[a]

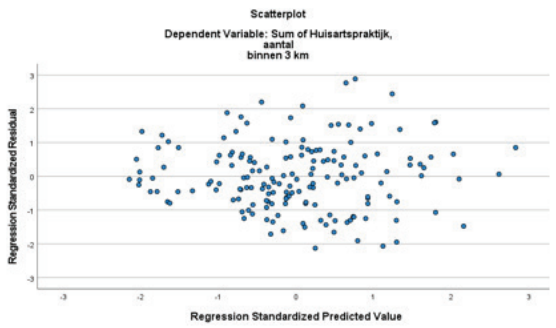
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.517	1.793		.288	.774		
	Sum of OAD	.004	.000	.777	13.604	<.001	.661	1.514
	Sum of tot 15 jaar	-.001	.000	-.148	-2.204	.029	.476	2.099
	Sum of 65 jaar en ouder	.001	.000	.137	2.014	.046	.467	2.143
	Sum of Bevolkingsontwikkeling	.001	.000	.073	1.537	.126	.958	1.044
	Sum of Huishoudgrootte	-.109	.725	-.008	-.150	.881	.696	1.437

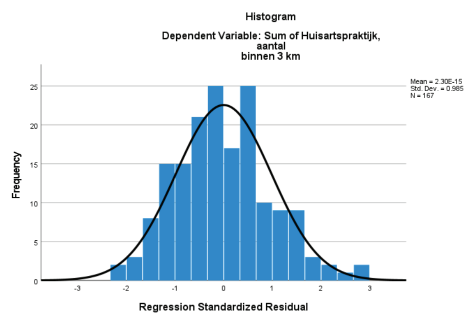
a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

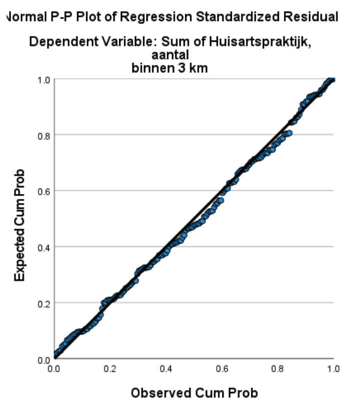
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	.220	17.068	7.489	3.3831	167
Residual	-5.3274	7.2297	.0000	2.4663	167
Std. Predicted Value	-2.149	2.831	.000	1.000	167
Std. Residual	-2.127	2.887	.000	.985	167

a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km







APPENDIX 8. REGRESSION ON GENERAL PRACTICES IN THE NETHERLANDS

75 outliers removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Huisartspraktijk, aantal binnen 3 km	3489	.0	33.1	3.204	4.0463	16.372
Sum of OAD	3489	2	6397	737.20	891.793	795295.569
Sum of tot 15 jaar	3489	0	6095	605.29	691.627	478348.532
Sum of 65 jaar en ouder	3489	0	5210	737.10	796.681	634701.006
Sum of Bevolkingsontwikkeling	3489	-4160	3335	82.61	294.787	86899.315
Sum of Huishoudgrootte	3489	.0	4.4	2.332	.3129	.098
Valid N (listwise)	3489					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.947[a]	.898	.898	1.2952	1.423

a. Predictors: (Constant), Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

b. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	51264.692	5	10252.938	6112.303	.000[b]
	Residual	5842.476	3483	1.677		
	Total	57107.169	3488			

a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

b. Predictors: (Constant), Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of tot 15 jaar, Sum of OAD, Sum of 65 jaar en ouder

Coefficients[a]

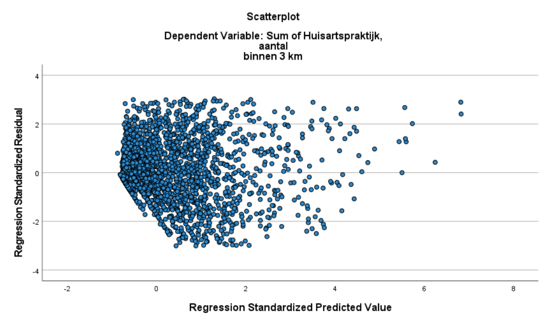
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.070	.218		.322	.748		
	Sum of OAD	.005	.000	1.034	130.032	.000	.465	2.153
	Sum of tot 15 jaar	.000	.000	-.046	-4.230	<.001	.248	4.038
	Sum of 65 jaar en ouder	-.001	.000	-.112	-10.739	<.001	.271	3.692
	Sum of Bevolkingsontwikkeling	.000	.000	.025	4.388	<.001	.927	1.079
	Sum of Huishoudgrootte	.098	.088	.008	1.116	.265	.634	1.577

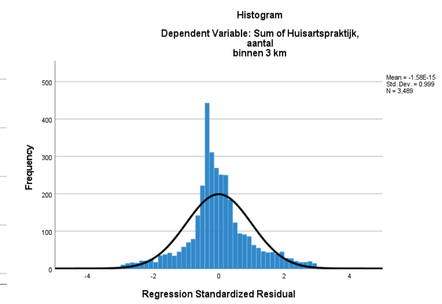
a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km

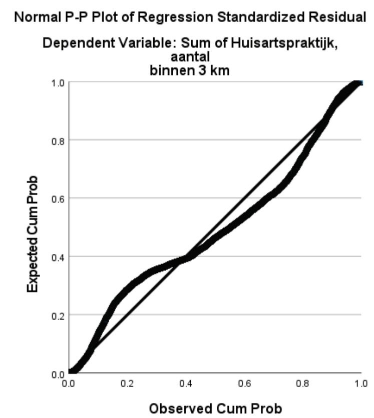
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-.133	29.380	3.204	3.8337	3489
Residual	-3.8937	3.9299	.0000	1.2942	3489
Std. Predicted Value	-.870	6.828	.000	1.000	3489
Std. Residual	-3.006	3.034	.000	.999	3489

a. Dependent Variable: Sum of Huisartspraktijk, aantal binnen 3 km







APPENDIX 9. REGRESSION ON CAFES IN NEW TOWNS

12 outliers removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Cafe, aantal binnen 3 km	155	.0	25.0	7.400	6.6964	44.841
Sum of Huishoudgrootte	155	.0	3.1	2.242	.3227	.104
Sum of 15 tot 25 jaar	155	0	3575	845.77	603.661	364406.215
Sum of Bevolkingsontwikkeling	155	-530	3040	187.90	583.932	340976.906
Sum of Treinstation, dichtstbijzijnde	155	.4	29.1	4.875	5.5762	31.094
Sum of OAD	155	18	3674	1672.95	767.714	589385.101
Valid N (listwise)	155					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.476[a]	.226	.200	5.9879	.753

a. Predictors: (Constant), Sum of OAD, Sum of Treinstation, dichtstbijzijnde, Sum of Bevolkingsontwikkeling, Sum of 15 tot 25 jaar, Sum of Huishoudgrootte

b. Dependent Variable: Sum of Cafe, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1563.162	5	312.632	8.719	<.001[b]
	Residual	5342.418	149	35.855		
	Total	6905.580	154			

a. Dependent Variable: Sum of Cafe, aantal binnen 3 km

b. Predictors: (Constant), Sum of OAD, Sum of Treinstation, dichtstbijzijnde, Sum of Bevolkingsontwikkeling, Sum of 15 tot 25 jaar, Sum of Huishoudgrootte

Coefficients[a]

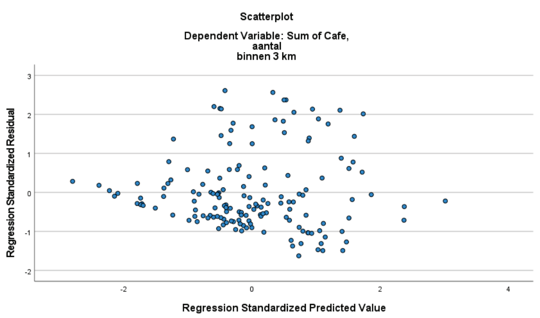
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	10.599	4.266		2.485	.014		
	Sum of Huishoudgrootte	-3.462	1.707	-.167	-2.028	.044	.767	1.303
	Sum of 15 tot 25 jaar	-.001	.001	-.059	-.715	.476	.772	1.295
	Sum of Bevolkingsontwikkeling	-1.391E-5	.001	-.001	-.016	.987	.943	1.061
	Sum of Treinstation, dichtstbijzijnde	-.125	.087	-.104	-1.441	.152	.990	1.010
	Sum of OAD	.003	.001	.392	4.652	<.001	.730	1.370

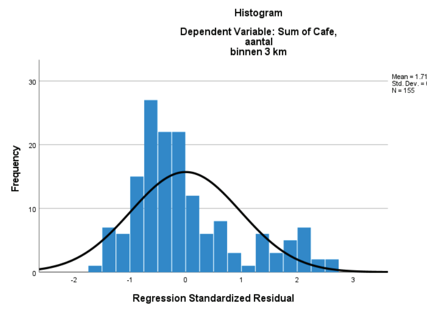
a. Dependent Variable: Sum of Cafe, aantal binnen 3 km

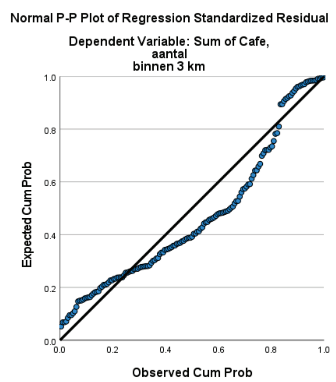
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.507	17.014	7.400	3.1860	155
Residual	-9.7335	15.6332	.0000	5.8899	155
Std. Predicted Value	-2.796	3.018	.000	1.000	155
Std. Residual	-1.626	2.611	.000	.984	155

a. Dependent Variable: Sum of Cafe, aantal binnen 3 km







APPENDIX 10. REGRESSION ON CAFES IN THE NETHERLANDS

50 outliers removed, 725 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Cafe, aantal binnen 3 km	3103	.0	24.7	3.210	3.8945	15.167
Sum of Huishoudgrootte	3103	.0	4.4	2.373	.2903	.084
Sum of 15 tot 25 jaar	3103	0	4770	392.31	464.956	216184.020
Sum of Bevolkingsontwikkeling	3103	-4160	4225	79.69	296.950	88179.199
Sum of Treinstation, dichtstbijzijnde	3103	.5	59.0	8.471	7.6717	58.854
Sum of OAD	3103	2	3976	556.15	643.522	414120.202
Valid N (listwise)	3103					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.772[a]	.596	.595	2.4785	1.080

a. Predictors: (Constant), Sum of OAD, Sum of Bevolkingsontwikkeling, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of 15 tot 25 jaar

b. Dependent Variable: Sum of Cafe, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28024.707	5	5604.941	912.415	.000[b]
	Residual	19024.787	3097	6.143		
	Total	47049.494	3102			

a. Dependent Variable: Sum of Cafe, aantal binnen 3 km

b. Predictors: (Constant), Sum of OAD, Sum of Bevolkingsontwikkeling, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of 15 tot 25 jaar

Coefficients[a]

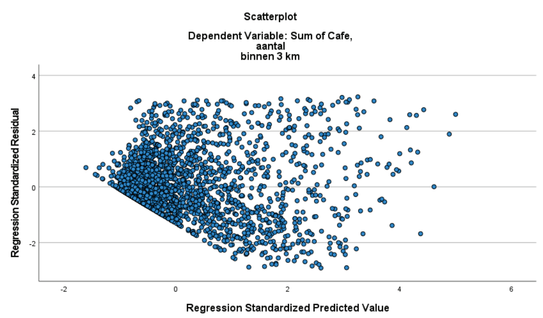
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.153	.417		9.958	<.001		
	Sum of Huishoudgrootte	-1.305	.164	-.097	-7.951	<.001	.873	1.146
	Sum of 15 tot 25 jaar	-.002	.000	-.209	-12.540	<.001	.468	2.136
	Sum of Bevolkingsontwikkeling	-.001	.000	-.046	-3.922	<.001	.941	1.062
	Sum of Treinstation, dichtstbijzijnde	-.007	.006	-.014	-1.173	.241	.905	1.106
	Sum of OAD	.005	.000	.877	48.912	.000	.406	2.460

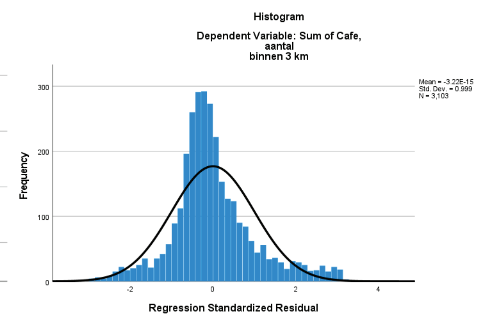
a. Dependent Variable: Sum of Cafe, aantal binnen 3 km

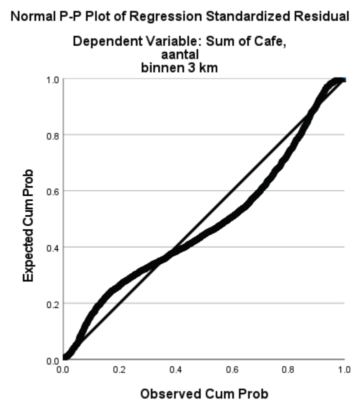
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.614	18.248	3.210	3.0057	3103
Residual	-7.2133	8.0034	.0000	2.4765	3103
Std. Predicted Value	-1.605	5.003	.000	1.000	3103
Std. Residual	-2.910	3.229	.000	.999	3103

a. Dependent Variable: Sum of Cafe, aantal binnen 3 km







APPENDIX 11. REGRESSION ON CAFETERIAS IN NEW TOWNS

8 outliers removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Cafetaria, aantal binnen 1 km	158	.0	10.9	2.595	2.5508	6.506
Sum of Huishoudgrootte	158	.0	3.1	2.246	.3135	.098
Sum of 15 tot 25 jaar	158	0	3575	851.33	598.354	358027.840
Sum of Bevolkingsontwikkeling	158	-530	3040	182.28	578.062	334155.922
Sum of Treinstation, dichtstbijzijnde	158	.7	29.1	4.830	5.5302	30.583
Sum of OAD	158	18	3509	1673.53	755.604	570937.079
Sum of 65 jaar en ouder	158	0	3360	1180.16	762.269	581054.274
Valid N (listwise)	158					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.535[a]	.287	.258	2.1968	1.763

a. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of 15 tot 25 jaar

b. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	292.768	6	48.795	10.111	<.001[b]
	Residual	728.728	151	4.826		
	Total	1021.496	157			

a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

b. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of 15 tot 25 jaar

Coefficients[a]

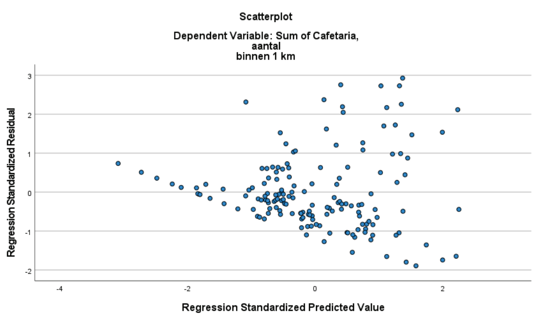
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.608	1.593		2.264	.025		
	Sum of Huishoudgrootte	-1.569	.645	-.193	-2.433	.016	.752	1.330
	Sum of 15 tot 25 jaar	.000	.000	-.066	-.604	.547	.398	2.510
	Sum of Bevolkingsontwikkeling	.001	.000	.160	2.243	.026	.930	1.075
	Sum of Treinstation, dichtstbijzijnde	-.033	.032	-.071	-1.006	.316	.954	1.048
	Sum of OAD	.001	.000	.420	4.993	<.001	.667	1.500
	Sum of 65 jaar en ouder	.000	.000	.102	.919	.359	.383	2.614

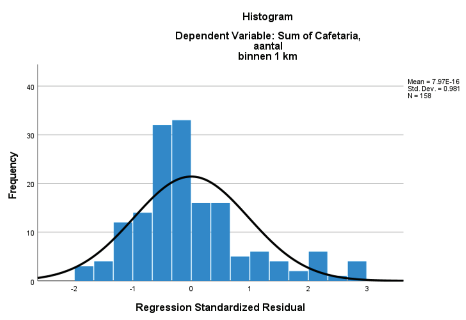
a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

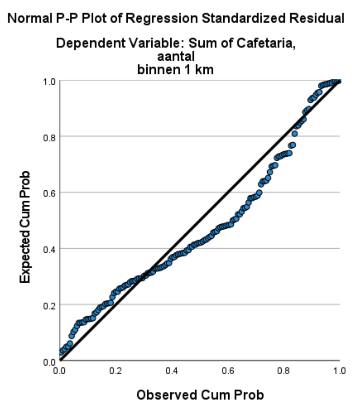
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.617	5.674	2.595	1.3656	158
Residual	-4.1558	6.4298	.0000	2.1544	158
Std. Predicted Value	-3.084	2.255	.000	1.000	158
Std. Residual	-1.892	2.927	.000	.981	158

a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km







9. APPENDIX

APPENDIX 12. REGRESSION ON CAFETERIAS IN THE NETHERLANDS

42 outliers removed, 438 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Cafetaria, aantal binnen 1 km	3398	.0	11.8	1.357	1.7377	3.020
Sum of Huishoudgrootte	3398	.0	4.4	2.353	.2997	.090
Sum of 15 tot 25 jaar	3398	0	4770	422.74	485.802	236003.487
Sum of Bevolkingsontwikkeling	3398	-4160	4225	81.16	304.591	92775.494
Sum of Treinstation, dichtstbijzijnde	3398	.5	59.0	7.882	7.4150	54.982
Sum of OAD	3398	2	5204	662.24	762.057	580730.204
Sum of 65 jaar en ouder	3398	0	4580	704.17	777.817	604998.845
Valid N (listwise)	3398					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.823[a]	.677	.676	.9890	1.756

a. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of OAD, Sum of 15 tot 25 jaar

b. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6940.767	6	1156.794	1182.620	.000[b]
	Residual	3316.949	3391	.978		
	Total	10257.715	3397			

a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

b. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of OAD, Sum of 15 tot 25 jaar

Coefficients[a]

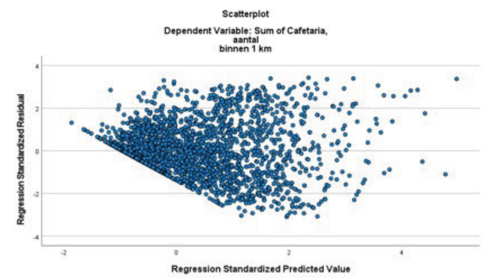
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.559	.161		9.678	<.001		
	Sum of Huishoudgrootte	-.666	.063	-.115	-10.529	<.001	.801	1.249
	Sum of 15 tot 25 jaar	.000	.000	-.113	-5.576	<.001	.231	4.335
	Sum of Bevolkingsontwikkeling	.000	.000	-.030	-2.997	.003	.947	1.056
	Sum of Treinstation, dichtstbijzijnde	.010	.002	.041	3.969	<.001	.883	1.132
	Sum of OAD	.001	.000	.610	40.433	<.001	.419	2.386
	Sum of 65 jaar en ouder	.001	.000	.352	18.616	<.001	.266	3.758

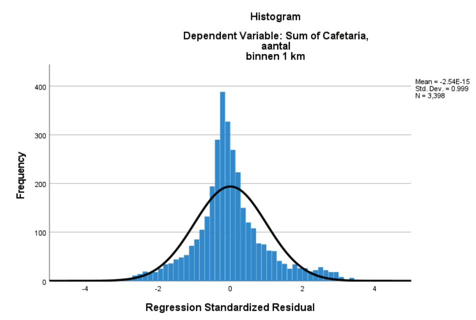
a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km

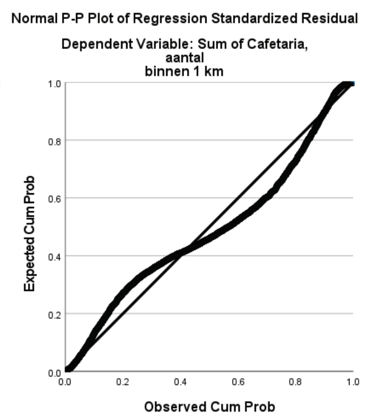
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.302	8.471	1.357	1.4294	3398
Residual	-3.0587	3.3866	.0000	.9881	3398
Std. Predicted Value	-1.860	4.977	.000	1.000	3398
Std. Residual	-3.093	3.424	.000	.999	3398

a. Dependent Variable: Sum of Cafetaria, aantal binnen 1 km







APPENDIX 13. REGRESSION ON EF&D IN NEW TOWNS

2 outliers removed, 0 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Dagelijkse levensmiddelen, aantal binnen 3 km	165	.0	91.9	29.685	19.3492	374.391
Sum of Huishoudgrootte	165	.0	3.1	2.224	.3231	.104
Sum of 15 tot 25 jaar	165	0	3575	843.88	593.739	352526.022
Sum of Bevolkingsontwikkeling	165	-530	3040	190.15	570.697	325695.251
Sum of Treinstation, dichtstbijzijnde	165	.4	29.1	4.684	5.4579	29.789
Sum of OAD	165	18	3994	1732.82	801.654	642648.894
Sum of 65 jaar en ouder	165	0	3360	1183.55	766.030	586801.835
Valid N (listwise)	165					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.798[a]	.636	.623	11.8855	1.029

a. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of 15 tot 25 jaar

b. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	39080.155	6	6513.359	46.107	<.001[b]
	Residual	22319.910	158	141.265		
	Total	61400.065	164			

a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

b. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of Bevolkingsontwikkeling, Sum of OAD, Sum of 15 tot 25 jaar

Coefficients[a]

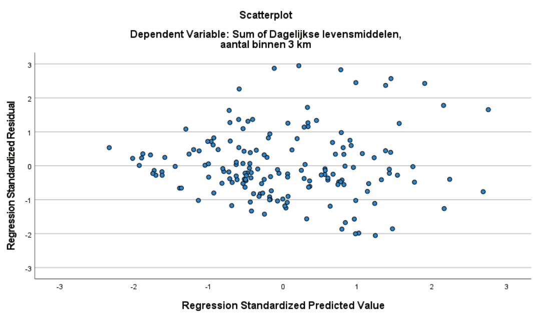
Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	15.873	8.474		1.873	.063		
	Sum of Huishoudgrootte	-5.215	3.412	-.087	-1.528	.128	.709	1.411
	Sum of 15 tot 25 jaar	-.009	.002	-.275	-3.591	<.001	.393	2.544
	Sum of Bevolkingsontwikkeling	.001	.002	.018	.373	.710	.951	1.052
	Sum of Treinstation, dichtstbijzijnde	-.550	.174	-.155	-3.151	.002	.950	1.052
	Sum of OAD	.017	.001	.699	11.809	<.001	.657	1.522
	Sum of 65 jaar en ouder	.005	.002	.207	2.682	.008	.385	2.599

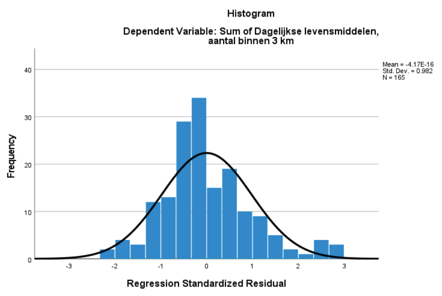
a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

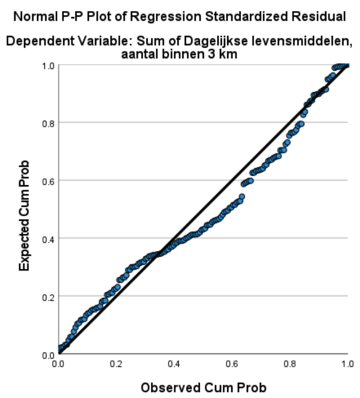
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-6.352	72.238	29.685	15.4368	165
Residual	-24.4209	35.0436	.0000	11.6661	165
Std. Predicted Value	-2.335	2.757	.000	1.000	165
Std. Residual	-2.055	2.948	.000	.982	165

a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km







9. APPENDIX

65 outliers removed, 571 missing values

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Sum of Dagelijkse levensmiddelen, aantal binnen 3 km	3242	.0	104.9	11.399	15.0928	227.793
Sum of Huishoudgrootte	3242	.0	4.4	2.354	.2968	.088
Sum of 15 tot 25 jaar	3242	0	4770	408.81	469.164	220115.081
Sum of Bevolkingsontwikkeling	3242	-4160	3335	76.46	280.320	78579.475
Sum of Treinstation, dichtstbijzijnde	3242	.5	59.0	8.232	7.6103	57.916
Sum of OAD	3242	2	4487	618.43	731.242	534714.361
Sum of 65 jaar en ouder	3242	0	5210	710.70	797.663	636265.997
Valid N (listwise)	3242					

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.954[a]	.910	.910	4.5286	1.544

a. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of Treinstation, dichtstbijzijnde, Sum of Huishoudgrootte, Sum of OAD, Sum of 15 tot 25 jaar

b. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	671931.054	6	111988.509	5460.605	.000[b]
	Residual	66344.820	3235	20.508		
	Total	738275.873	3241			

a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

b. Predictors: (Constant), Sum of 65 jaar en ouder, Sum of Bevolkingsontwikkeling, Sum of Treinstation,
dichtstbijzijnde, Sum of Huishoudgrootte, Sum of OAD, Sum of 15 tot 25 jaar

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	2.883	.792		3.643	<.001		
	Sum of Huishoudgrootte	-.842	.310	-.017	-2.714	.007	.747	1.339
	Sum of 15 tot 25 jaar	-.002	.000	-.047	-3.904	<.001	.194	5.157
	Sum of Bevolkingsontwikkeling	-.001	.000	-.010	-1.811	.070	.946	1.057
	Sum of Treinstation, dichtstbijzijnde	-.054	.011	-.027	-4.846	<.001	.893	1.120
	Sum of OAD	.022	.000	1.067	124.609	.000	.379	2.642
	Sum of 65 jaar en ouder	-.003	.000	-.151	-13.534	<.001	.223	4.491

a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-1.846	91.171	11.399	14.3987	3242
Residual	-13.6018	14.1173	.0000	4.5244	3242
Std. Predicted Value	-.920	5.540	.000	1.000	3242
Std. Residual	-3.004	3.117	.000	.999	3242

a. Dependent Variable: Sum of Dagelijkse levensmiddelen, aantal binnen 3 km