MASTER

Collective private commissioning
A supportive tool for location evaluation

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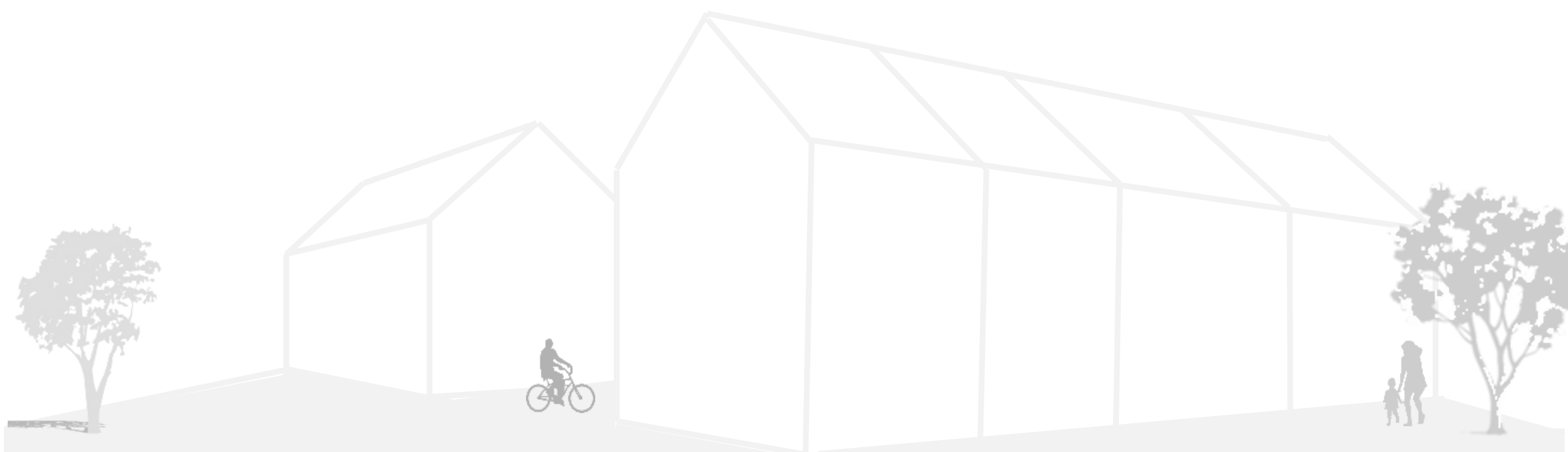

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Preface

Dear reader,

This thesis has been written to obtain the master degrees in Architecture, Building & Planning and in Construction Management and Engineering. Writing this master thesis concludes my academic career at the Eindhoven University of Technology.

In the past year I have executed this research with great pleasure and effort. In this year, I have learned several new skills that I can hopefully use in the professional field. This thesis is partly written out of personal concerns of the current state of the Dutch housing market and with this thesis I hope to make a positive contribution to solving it.

I would like to thank all my supervisors for their help and guidance, not only during writing this thesis but also during my previous years at the university. I would also like to thank all respondents and CPC groups that helped by responding and distributing the stated choice experiments. Foremost, I would like to express special gratitude to my first supervisors Peter van der Waerden and Stephan Maussen for their guidance.

Furthermore I would like to thank my family and friends for their support during this last year and by providing feedback or advice whenever asked for.

I can safely say that I present to you this thesis with proud and hope you may find use and joy while reading it.

Jasper Poel
Drunen, January 2024.

Summary

The Dutch housing market is under pressure. This can be seen back in the rising property prices in the last years. In the last five years, the average price of a dwelling has risen with 45%. The most important contributor to this development is the lack of suitable, affordable houses, which causes a mismatch between suitable housing demand and supply. This problem is felt across society and is not uncommon amongst vulnerable groups on the housing market, such as elderly and starters. An approach for developing more suitable homes is Collective Private Commissioning (CPC). CPC initiatives can be identified as a form of social project development, allowing future occupants to collectively act as initiator of the construction project. Added benefits are that it allows for a faster development process, often leading to an increased price-to-quality ratio and more sustainable homes. Furthermore, active participation in such projects could reduce the levels of loneliness and social exclusion, while increasing the sense of control and design freedom.

This thesis aimed to investigate the location related preferences of the CPC community and to use this information to develop a tool that guides the CPC groups in finding their ideal location for development. This tool is developed to help CPC participants in reducing the time and effort necessary during the location identification process, since at the moment, people participating in CPC projects often spend more than two years on identifying a suitable location. Ultimately, this tool could make it more attractive for people to participate in CPC projects causing more dwellings to be built in a shorter time span. This would aid the housing market by providing more suitable homes. In this thesis, the main research question is: "How can a tool to identify the suitability level of locations for CPC developments be designed based on the preferences of the CPC community?"

In this thesis, the literature study helped to identify what location related attributes influence the residential decision making of people and what the preferences of people regarding these attributes are. To determine the preferences of the CPC community on location related attributes, data is gathered using a stated choice experiment. The location related attributes used in this experiment are based on the findings of the literature study. A discrete choice analysis quantified the preferences of the CPC community. A suitability analysis was then performed to identify all suitable locations for CPC development and their suitability levels. GIS systems were used to conduct a general exclusion assessment, acquire plot data and extract relevant attribute values. A general exclusion assessment removed all plots that are unsuitable for all residential development projects. The plot data (the locations for CPC development) functions as the base layer in the suitability analysis. The overall suitability score of a plot was the result of applying a weighted linear combination (WLC) approach. In this approach, the weights determined in the discrete choice analysis and attribute values acquired with GIS were combined. The suitability analysis resulted in a dataset that contains all relevant location information. This dataset is used in the development of an interactive suitability tool. In this tool, people interested in CPC participation can conduct a case-specific suitability analysis within their area of interest.

In the literature study it has been found that location is one of the most important contributors in residential decision making, together with the dwelling characteristics, price and personal requirements. The location of a dwelling can be characterized by a variety of location attributes of which the most important ones are related to the socio-demographic composition of the neighbourhood, cleanliness and safety and accessibility to transportation, social, cultural and environmental facilities. The preferences of people regarding location related attributes in residential decision making can vary based on the socio-economic characteristics of people. For example, younger people might prefer to live close to educational facilities, while retirees might prefer to live close to medical facilities. It was furthermore found that socio-economic characteristics of people interested in CPC projects can differ within and between groups for characteristics such as age, household composition and nationality.

A stated choice experiment was used to gather data for determining the weights of the selected location related attributes and attribute levels. The selection of these attributes was based on the findings of the literature review. A stated choice experiment was used since it is an accepted approach for determining preferences of individuals regarding housing choices in situations where no previous data exists. The selected attributes in this stated choice experiment were the price of the plot, urban location, level of green in the neighbourhood, the possibility of having communal spaces and the proximity to the supermarket, public transport stops, and cycling network. In the stated choice experiment, respondents were presented with choice tasks, which asked the respondent to choose a preferred location from two presented locations. The presented locations varied based on the seven attributes which all had three attribute levels. In total, data from 163 respondents were analysed covering 1467 evaluations, as every respondent was presented with nine choice tasks.

A descriptive analysis investigated the socio-economic characteristics of the respondents, their motives in residential decision making and, if applicable, CPC project characteristics. The descriptive analysis showed that in the sample, CPC respondents consisted more of older respondents in comparison with the Dutch population. This descriptive analysis also found that an increased level of experience with CPC projects results in a decreased sense of importance for the affordability of a new home, but higher importance levels for sustainable dwellings, design freedom and neighbourliness. Also, the descriptive analysis showed that the presence of communal facilities, private gardens, sustainability interventions (e.g. solar panels) and the possibility to have newly constructed dwellings influences the locational decision making of the CPC community. A discrete choice analysis was conducted to determine the weights for every location related attribute and attribute levels. A multi-nominal logit (MNL) model and latent class (LC) model were used to determine these weights. These weights indicated whether the preference was positive or negative and indicated the strength of the preferences. The results of the MNL model showed that respondents prefer a lower price for the plot, prefer locations in the edges of cities (0.166), strongly prefer locations where there is a high level of greenery in the neighbourhood (0.652) and prefer locations further away from the cycling network (0.195). In the LC analysis, four groups were identified. It was found that respondents with more CPC experience in the sample could be assigned to two of these groups: CPC experienced respondents preferring inner city locations (LC group 4, weight 0.871) and CPC experienced respondents preferring rural locations (LC group 3, weight 1.639). Respondents with more CPC experience that prefer rural locations also prefer locations within a ten minute walking distance to a PT stop (0.521), have the strongest preference for locations in highly green neighbourhoods (2.422) and prefer the possibility of having outdoor communal spaces (0.707). Respondents with more CPC experience that prefer inner city locations strongly prefer to have the possibility of having both types of communal spaces (1.345). People with more CPC experience in general have stronger preferences for the proximity to the supermarket, the level of greenery and the possibility of having communal spaces.

A land suitability analysis was conducted with GIS software using vector data focussing on the province Noord-Brabant in The Netherlands. The suitability analysis used plots identified by municipal landuse plans as the base layer. For every attribute, a vector data layer was created which contained geospatial information (e.g. locations of supermarkets, level of greenery in the neighbourhood). Relevant data was extracted from these vector layers and added to the base layer. The weights determined in the latent class model for group 3 were used to determine the suitability scores.

The developed suitability tool was based on the dataset created in the suitability analysis. The tool can be used to identify suitable plots for the project of the CPC group of the user, to identify the suitability levels of the found plots and to identify what plot is most suitable. This tool consists of an online and offline component. The online component can be used to identify how many plots are suitable in the desired area of interest. The online component of the tool was developed with the ArcGIS WebAppBuilder and is freely accessible online. In the online component of the tool, users can apply filters on the data, set the area of interest and visualize the results of the suitability assessment. The offline component of the tool can be used to determine the suitability level of the identified plots and to determine what plot is most suitable. The offline component of the tool is a Microsoft Excel document. In the Excel document, respondents can calculate the minimum size of the plot for their CPC project, set what attributes should be included in their suitability analysis and indicate how important they rate these attributes. Based on the personalized preferences, case-specific suitability scores can be calculated for every identified plot. The Excel document provides information of the overall suitability score of a plot and the individual, attribute related, suitability scores. The developed tool is illustrated by a case study.

In this thesis it was concluded that respondents with more CPC experience can be classified in two groups based on the latent class model: those that prefer inner city locations and those that prefer rural locations. The only other preference for CPC experienced respondents that prefer inner city locations, is to have the possibility to create both types of communal spaces, indicating that they have less location related preferences in residential decision making. CPC experienced respondents that prefer rural locations however, have the strongest preference for locations in a very green neighbourhood, prefer the possibility of having outdoor communal spaces and a public transport stop at a ten minute walking distance. Other aspects of CPC projects that influenced the locational decision making are the presence of private gardens, sustainability interventions and the possibility to construct new-build dwellings. The developed tool consists of several functionalities of which the most important are: to set the area of interest, to set filters and to determine the suitability scores. These were successfully combined in a functional tool for location identification and assessment.

Recommendations for improvement consist of acquiring a larger dataset by having an increased number of respondents of the stated choice experiment, to conduct the analysis on plots defined by cadastre data instead of landuse plans, to expand the tool to include also other provinces than Noord-Brabant and to develop a tool in which all functionalities can be accessed in one (online) software program instead of splitting the tool into an online and offline component.

Samenvatting

De Nederlandse huizenmarkt staat onder druk. Dit is terug te zien in de stijgende huizenprijzen van de afgelopen jaren. In de afgelopen vijf jaar is de gemiddelde prijs van een woning met 45% gestegen. De belangrijkste oorzaak van deze ontwikkeling is het gebrek aan geschikte, betaalbare woningen, waardoor er een mismatch is tussen de vraag naar geschikte woningen en het aanbod. Dit probleem doet zich overal in de samenleving voor en is niet ongewoon bij kwetsbare groepen op de woningmarkt, zoals ouderen en starters. Een manier om meer geschikte woningen te ontwikkelen is Collectief Particulier Opdrachtgeverschap (CPO). CPO projecten kunnen worden geïdentificeerd als een vorm van sociale projectontwikkeling, waarbij toekomstige bewoners collectief optreden als initiatiefnemer van het bouwproject. Bijkomende voordelen zijn dat het een sneller ontwikkelingsproces mogelijk maakt, wat vaak leidt tot een betere prijs-kwaliteit verhouding en duurzamere woningen. Bovendien zou actieve deelname aan dergelijke projecten eenzaamheid en sociale uitsluiting kunnen verminderen, terwijl het gevoel van controle en ontwerpvrijheid kan toenemen.

Deze thesis had als doel de locatie gerelateerde voorkeuren van de CPO gemeenschap te onderzoeken en deze informatie te gebruiken om een hulpmiddel te ontwikkelen dat CPO participanten begeleidt bij het vinden van hun ideale locatie. Deze tool werd ontwikkeld om CPO deelnemers te helpen met het verminderen van de tijd en moeite die nodig is tijdens het identificatieproces van de locatie, aangezien op dit moment mensen die deelnemen aan CPO projecten vaak meer dan twee jaar besteden aan het identificeren van een geschikte locatie. Uiteindelijk zou dit het voor mensen aantrekkelijker kunnen maken om deel te nemen aan CPO projecten, waardoor er meer woningen in een kortere tijdspanne kunnen worden gebouwd. Dit zou de woningmarkt ten goede komen doordat er meer geschikte woningen beschikbaar komen. In deze thesis luidt de belangrijkste onderzoeksvraag: "Hoe kan een instrument worden ontworpen om het geschiktheidsniveau van locaties voor CPO ontwikkelingen te bepalen op basis van de voorkeuren van de CPO gemeenschap?”

Op basis van de literatuurstudie zijn locatie gerelateerde attributen geïdentificeerd die van invloed zijn op het nemen van woonbeslissingen en wat de voorkeuren van mensen zijn met betrekking tot deze attributen. Hiervoor werden eerst gegevens verzameld met behulp van een gestelde-voorkeuren experiment. De locatie gerelateerde attributen die in dit experiment werden gebruikt, waren gebaseerd op de bevindingen van de literatuurstudie. Een discrete keuzeanalyse was gebruikt om de voorkeuren van de CPO gemeenschap te kwantificeren. Na het afronden van de analyse werd er een geschiktheidsanalyse uitgevoerd om alle geschikte locaties voor CPO ontwikkeling en hun geschiktheidsniveaus te identificeren. GIS systemen werden gebruikt om een algemene uitsluitingsbeoordeling uit te voeren, perceelgegevens te verzamelen en relevante attribuutwaarden te verkrijgen. Een algemene uitsluitingsbeoordeling verwijderde alle percelen die ongeschikt zijn voor alle woningbouwprojecten. De perceel (locatie voor CPO ontwikkeling) data dienden als basislaag voor de geschiktheidsanalyse. De totale geschiktheidsscore van een perceel is het resultaat van de toepassing van een gewogen lineaire combinatie. In deze benadering werden de gewichten die waren bepaald in de discrete keuzeanalyse en de attribuutwaarden die zijn verkregen met GIS gecombineerd. De geschiktheidsanalyse resulteerde in een dataset die alle relevante locatie informatie bevatte. Deze dataset werd gebruikt in de

interactieve geschiktheidstool. In deze tool kunnen mensen die geïnteresseerd zijn in CPO deelname een locatie geschiktheidsanalyse uitvoeren binnen hun zoekgebied specifiek voor hun CPO project.

Uit de literatuurstudie was gebleken dat de locatie een van de belangrijkste factoren is bij het nemen van woonbeslissingen, samen met de woningkenmerken, de prijs en persoonlijke eisen en wensen. De locatie van een woning kan worden gekarakteriseerd door een verscheidenheid aan locatie gerelateerde attributen waarvan de belangrijkste verband houden met de sociaal-demografische samenstelling van de buurt, netheid, veiligheid en toegankelijkheid tot vervoers-, sociale, culturele en natuur (park, bos etc.) voorzieningen. De voorkeuren van mensen met betrekking tot locatie gerelateerde attributen bij het nemen van woonbeslissingen kunnen variëren op basis van de sociaaleconomische kenmerken van mensen. Jongeren wonen bijvoorbeeld liever dicht bij de onderwijsinstellingen, terwijl gepensioneerden liever dicht bij medische voorzieningen wonen. Uit de literatuurstudie was ook gebleken dat sociaaleconomische kenmerken van mensen die geïnteresseerd zijn in CPO projecten kunnen verschillen binnen en tussen groepen voor kenmerken als leeftijd, huishoudenssamenstelling en nationaliteit.

Een gestelde-voorkeuren experiment was gebruikt om gegevens te verzamelen voor het bepalen van de gewichten van de geselecteerde locatie gerelateerde attributen en attribuutniveaus. De selectie van deze kenmerken was gebaseerd op de bevindingen van het literatuuronderzoek. Er was gebruik gemaakt van een gestelde-voorkeuren experiment omdat dit een geaccepteerde aanpak is voor het bepalen van voorkeuren van individuen met betrekking tot woningkeuzes in situaties waarin geen eerdere gegevens voorhanden zijn. In het gestelde-voorkeuren experiment werd respondenten gevraagd een voorkeurslocatie te kiezen uit twee gepresenteerde locaties, die variëren op basis van zeven attributen die allemaal drie attribuutniveaus hebben. De geselecteerde attributen waren onder andere de prijs van het perceel, de stedelijkheid, de mate van groen in de buurt, de mogelijkheid om gemeenschappelijke ruimtes te bouwen en de nabijheid van de supermarkt, haltes van het openbaar vervoer en het fietsnetwerk. In totaal werden de gegevens van 163 respondenten geanalyseerd met betrekking tot 1467 beoordelingen, aangezien elke respondent negen keuzetaken was voorgelegd.

Een beschrijvende analyse onderzocht de sociaaleconomische kenmerken van de respondenten, hun motieven bij het nemen van woonbeslissingen en, indien van toepassing, de kenmerken van het CPO project. Daaruit kon worden geconcludeerd dat in de steekproef de CPO respondenten meer uit oudere respondenten bestaan in vergelijking met de Nederlandse bevolking. Ook werd bevonden dat mensen met een hogere mate van ervaring met CPO projecten minder belang hechten aan de betaalbaarheid van een nieuwe woning, maar meer belang hechten aan duurzame woningen, ontwerpvrijheid en nabuurschap. Ook bleek uit de beschrijvende analyse dat de aanwezigheid van gemeenschappelijke voorzieningen, privétuinen, duurzame toepassingen (bijv. zonnepanelen) en de mogelijkheid om nieuw gebouwde woningen te realiseren van invloed zijn op de locatiebeslissingen van de CPO gemeenschap. Een discrete keuzeanalyse is gebruikt om de gewichten te bepalen voor elk locatie gerelateerd kenmerk en kenmerkniveau. In dit onderzoek waren een multinominaal logit (MNL) model en een latent klassenmodel gebruikt om deze gewichten te bepalen. Deze gewichten gaven aan of de voorkeur positief of negatief is en gaven de sterkte van de voorkeur aan. De resultaten van het MNL model lieten zien dat respondenten de voorkeur geven aan een lagere prijs voor de kavel, een voorkeur hebben voor locaties aan de rand van steden (0.166), een sterke voorkeur hebben voor locaties met veel groen in de buurt (0.652) en een voorkeur hebben voor locaties die verder van het fietsnetwerk liggen (0.195). In de LC analyse werden vier verschillende groepen geïdentificeerd. In de LC analyse bleek dat respondenten met meer CPO ervaring konden worden gekoppeld aan twee van deze groepen: CPO ervaren respondenten met een voorkeur voor binnenstedelijke locaties (LC-groep 4, gewicht 0.871) en respondenten met een voorkeur voor landelijke locaties (LC-groep 3, gewicht 1.639). Respondenten met meer CPO ervaring die de voorkeur geven aan landelijke locaties, geven ook de voorkeur aan locaties op een loopafstand van tien minuten van een halte van het openbaar vervoer (0.521), hebben de sterkste voorkeur voor locaties in zeer groene buurten (2.422) en geven de voorkeur aan de mogelijkheid om gemeenschappelijke buitenruimten te creëren (0.707). Respondenten met meer CPO ervaring die een voorkeur hebben voor binnenstedelijke locaties hebben alleen een sterke voorkeur voor de mogelijkheid om beide typen gemeenschappelijke ruimten te creëren (1.345).Mensen met meer CPO ervaring hebben ook minder sterke voorkeuren voor de prijs van de kavel, maar hebben sterkere voorkeuren voor de nabijheid van de supermarkt, de mate van groen en de mogelijkheid om gemeenschappelijke ruimtes te bouwen.

Een geschiktheid analyse was uitgevoerd met GIS-software waarbij gebruik is gemaakt van vectorgegevens. In deze analyse werd alleen de provincie Noord-Brabant in Nederland onderzocht. In de geschiktheidsanalyse zijn percelen die waren geïdentificeerd door bestemmingsplannen gebruikt als basislaag. Vervolgens was voor elk afzonderlijk kenmerk een vector data laag gemaakt die ruimtelijke informatie bevatte (bijv. locaties van supermarkten, mate van groen in de wijk). Relevante gegevens werden uit deze vectorlagen gehaald en toegevoegd aan de basislaag. Zodra alle benodigde ruimtelijke informatie was gecombineerd in de basislaag, kon de geschiktheidsscore worden berekend aan de hand van de bepaalde gewichten voor latente klasse groep 3.

De ontwikkelde geschiktheidstool was gebaseerd op de dataset die tijdens de geschiktheidsanalyse was gecreëerd. De tool kan door de gebruiker worden gebruikt om geschikte percelen te identificeren voor het CPO project van CPO groep van de gebruiker, om de geschiktheidsniveaus van de gevonden percelen te identificeren en om te bepalen welk perceel het meest geschikt is. Deze tool bestaat uit een online en offline component. De online component kan worden gebruikt om te bepalen hoeveel percelen geschikt zijn in het gewenste zoekgebied. De online component van de tool was ontwikkeld met de ArcGIS WebAppBuilder en is online toegankelijk. In de online component van de tool kunnen gebruikers filters toepassen op de gegevens, het interessegebied instellen en de resultaten van de geschiktheidsbeoordeling visualiseren. De offline component van de tool kan worden gebruikt om het geschiktheidsniveau van de geïdentificeerde percelen te bepalen en om te bepalen welk perceel het meest geschikt is. De offline component van de tool is een Microsoft Excel document. In het Excel document kunnen respondenten de minimale grootte van het perceel voor hun CPO project berekenen, bepalen welke attributen moeten worden meegenomen in hun geschiktheidsanalyse en aangeven hoe belangrijk ze deze attributen vinden. Op basis van de aangegeven voorkeuren kunnen casus specifieke geschiktheidsscores worden berekend voor elk geïdentificeerd perceel. Het Excel document geeft informatie over de algehele geschiktheidsscore van een perceel en de individuele, kenmerk gerelateerde, geschiktheidsscores. De ontwikkelde tool is gebruikt in een casus.

In deze thesis is geconcludeerd dat respondenten met meer CPO ervaring kunnen worden ingedeeld in twee groepen: degenen die de voorkeur geven aan binnenstedelijke locaties en degenen die de voorkeur geven aan landelijke locaties. Respondenten met CPO ervaring die de binnenstad prefereren, hebben ook de voorkeur voor de mogelijkheid om beide gemeenschappelijke ruimten te creëren. Ervaren CPO respondenten met een voorkeur voor landelijke locaties hebben echter de sterkste voorkeur voor locaties in een zeer groene buurt, geven de voorkeur aan de mogelijkheid om gemeenschappelijke buitenruimten te hebben en een halte van het openbaar vervoer op tien minuten loopafstand. Andere aspecten van CPO projecten die de locatiebeslissing hebben beïnvloed zijn de aanwezigheid of mogelijkheid tot privétuinen, duurzame toepassingen en de mogelijkheid om nieuwbouwwoningen te bouwen. De ontwikkelde tool bestaat uit meerdere functionaliteiten waarvan de belangrijkste zijn: het bepalen van een zoekgebied, het toepassen van filters en het bepalen van de geschiktheidsscores. Al deze functionaliteiten zijn succesvol gecombineerd in een werkende tool voor locatie identificatie en onderzoek.

Aanbevelingen voor verbetering bestaan uit het verkrijgen van een grotere dataset door het verwerven van een groter aantal respondenten van het gestelde-voorkeuren experiment, het uitvoeren van de analyse op kavels gedefinieerd door kadastergegevens in plaats van bestemmingsplannen, het uitbreiden van de tool naar andere provincies en het ontwikkelen van een tool waarin alle functionaliteiten toegankelijk zijn in één (online) softwareprogramma in plaats van het opsplitsen van de tool in een online en offline component.

Abstract
The Dutch housing market is under pressure due to a problematic lack of suitable and affordable dwellings. Because of this, housing prices are rapidly rising causing problems across society. Building more suitable and affordable houses on the shorter time span is the most prominent solution to battling this problem. In this study, the focus is on collective private commissioning (CPC) as a solution to rapidly build more suitable houses to relieve the stress on the Dutch housing market. This study aimed to generate more knowledge on the factors influencing decision making of CPC participants and to provide these CPC participants with a tool to guide them in the location identification process. This would help the CPC participants by speeding up the longest step in the CPC development process. In this tool, users are able to select what location attributes they want to include, how important they value these attributes and apply these criteria to their desired area of interest. The foundation of this tool was a land suitability analysis using vector data, geographic information systems and a weighted linear combination approach. Here, weights were extracted from a discrete choice analysis that used data based on a stated choice experiment. From the discrete choice analysis was concluded that people with more CPC experience that prefer locations in the rural landscape also strongly prefer locations in highly green neighborhoods and easy access to the public transport system. CPC experienced people that prefer inner city locations however only prefer the possibility of having communal indoor and outdoor spaces. With the developed tool, people interested in CPC projects can quickly assess whether suitable plots are present in their desired area of interest and if so, which plot can be considered most suitable.

Key words: collective private commissioning, land suitability, location, residential decision making

List of abbreviations

CPC	Collective Private Commissioning
SCE	Stated choice experiment
DCM	Discrete choice model
MNL	Multi-nominal logit
LC	Latent class
GIS	Geographic Information System(s)

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1. Introduction

The Dutch social and political landscape has prioritized the importance of building significantly more affordable houses. In this chapter, this problem is further elaborated. Also, in this chapter the aim of the research, the research questions, research design and relevance of the thesis are introduced, followed by the reading guide.

1.1. Context and problem definition

The housing market in The Netherlands is under pressure. This problem can be seen back in the rising property prices. The average price of an owner-occupied home has risen with 45% in the last five years and with 106% (!) in the last ten years (Volkskrant, 2023). Despite the temporal cooling of the housing market during the first half of 2023, it is even expected that the property prices will continue to increase starting 2024 (RTLNieuws, 2023). The most important contributor to these price increases is the lack of sufficient (affordable) houses. At the moment (Q4, 2023), it is estimated that there is a shortage of 390,000 dwellings in the Dutch housing market (Ministry of the Interior and Kingdom Relations, 2023). This number is even expected to grow to 397,000 in 2027, before reducing to 205,000 in 2038 (Ministry of the Interior and Kingdom Relations, 2023). The reason for the expected growth is due to the inability to rapidly build more homes, with most shortages expected and felt in larger cities in or around Amsterdam and the western lands (RTLNieuws, 2022). These shortages can be found across all demographic groups. However, some groups are more affected than others. For example low or middle income households, students (Rijksoverheid, n.d.-a), starters and elderly (RTLNieuws, 2022) face sincere difficulties on the housing market. The shortage of suitable homes has moved the Dutch Ministry of Housing and Planning to agree that 900,000 new dwellings need to be built by 2030, of which two thirds need to be labelled 'affordable'. Most of these dwellings will be built in Noord- and Zuid-Holland, Noord-Brabant and Gelderland, the most densely populated provinces in the country (Rijksoverheid, 2022).

Another reason for the pressure on the housing market is that there is a mismatch between housing supply and demand. Phrased simply, there are too many people or households looking for a house, while there are not enough houses to accommodate all these people. The CBS (2022) has examined the main differences in housing demand between the years 2014 and 2021. One group that has a significant influence on the Dutch housing market are the older generations. The relative size of this demographic group (ages 65 and older) has increased from 17.4% in 2014 to 20.1% in 2022, and is even expected to grow by 39.5% in the next 20 years (Bouwinvest, 2021). This demographic group faces problems on the housing market as there are not enough suitable homes for this demographic group, whether for living independently or in a care home. If the older generations cannot move to a more suitable location, their current homes will not become available for future generations causing a negative ripple on the housing supply (NOS, 2021). According to STEC Groep (n.d.), one new dwelling for an elderly household could lead to up to five additional more movements on the housing market. They stress furthermore, that there is not one suitable dwelling for the entire elderly group. Some favour apartments or land bound dwellings, individual or shared living and urban to rural living.

Also the sizes of the households have a considerate impact on the size and composition of the housing demand. The number of one person households has increased by over 10% in the years 2014 to 2021, while the number of two person households had increased by almost 6%. To put these numbers in perspective, the number of five-person households has only risen with 0.9% and the number of four-person households has decreased with 0.6%. Because of these changes, the average household size has decreased considerably in the last years. These changes have had a serious impact on the housing demand. Smaller households in a growing population means that the total number of households will increase significantly. Furthermore, it distorts the match between available houses and the possibilities or wishes of the households. As the household sizes decrease, the housing stock relatively exists of too many too large homes, which translates in more (or too) expensive properties. (CBS, 2022a)

Building new homes to accommodate all people in a country as densely populated as The Netherlands is not an easy task. This task is even more difficult considering the objective to build more homes while also respecting the sustainability guidelines (De Hypotheker, 2019). There are however several building methods to reduce the development costs. Transforming existing (vacant) buildings into dwellings is found to be a sustainable alternative to demolition, as it saves materials and their transportation, and produces less waste (Remøy & van der Voordt, 2014). The study by Remøy & van der Voordt (2014) stressed that costs associated with redevelopment projects are lower and the building process takes less time as the main structure is already present. However, transformation of vacant buildings into dwellings is only considered feasible when the supply matches the demand regarding the location and living environment, property characteristics and individual home characteristics (Geraedts & De Vrij, 2004). Therefore, it is important to stress what locational and spatial attributes are in demand and how they vary across society. Location qualities that contribute to the desirability of a location can be diverse and vary for different demographic groups (Hernandez Quiñones, 2017).

Another method of building more affordable homes is to build according to the collective private commissioning (CPC) method. CPC development projects allows future residents to be both the client, future user, as well as investor. By being more involved in the decision making process, this method might result into more suitable homes to be build, regarding liveability, sustainability, while also enhancing the price-to-quality ratio (Bouwen in Eigen Beheer, n.d.). These projects facilitate better neighbourhood facilities that result in more social cohesion and interaction, maintenance of local social networks, neighbour support, sense of community and safety perception (Van der Wielen, 2017). People interested in CPC projects come from all layers of society, showing a great diversity in household income, age, household composition, gender and nationality. On average, this construction method has a duration of 2.5 years, while the average traditional construction method takes up to 10 years (Ministry of the Interior and Kingdom Relations, n.d.). At the moment however, theoretical knowledge on CPC is lacking and the identification of locations is found to be one of the most difficult and time-extensive tasks in the process.

In the current literature, no studies are conducted that investigate the location related preferences of the CPC community. Furthermore, there are no tools or frameworks available to the CPC community that help them in their decision making process. This thesis aims to fill these gaps by investigating the location related preferences of the CPC community and to use this information to develop a tool that guides the CPC groups in finding their ideal location for development. This topic is socially relevant since CPC groups often experience trouble finding a suitable location for development, which could often take more than two years. By bringing all the necessary information for location identification together in an accessible, transparent and systematic tool, the developed tool could help increase the ease and speed of finding a suitable location for CPC development. Ultimately, this tool can help to increase the interest in CPC projects, leading to the construction of more suitable housing for a variety of target groups.

1.2. Research questions

This thesis aims to contribute to tackling the pressure on the Dutch housing market by offering people interested in CPC projects a tool for identifying suitable locations to develop. This tool should be available and usable for everyone who wishes to do so and will be based on both theoretical as practical insights derived from this study. This study investigates what location characteristics should be included in the tool, how these are perceived by the CPC community and how this knowledge can be translated into an interactive tool. These elements can be found back in the research questions. The main research question is:

"How can a tool to identify the suitability level of locations for CPC developments be designed based on the preferences of the CPC community?"

Following the main research question, the following sub-questions are identified:

I. Which location related attributes and project related characteristics influence the preferences in residential decision making?
II. Which location related attributes and project related characteristics are considered most important by the CPC community?
III. What functionalities should the tool for location evaluation have and how can these functionalities be implemented?

1.3. Research design

This thesis consists of a combination of acquiring academic insights and the development of a tool. Figure 1 shows the schematic design of the thesis, which starts with a literature study of which the results will be used to create a stated choice experiment. This experiment is used to acquire a dataset regarding the location preferences of the CPC community. This dataset will be analysed in function of weight determination. The results of this analysis can be used to conduct a land suitability analysis. The output of the suitability analysis will be used to develop an interactive tool for personal location suitability assessment. Using the tool will be demonstrated in a case study. The thesis will end with a conclusion where recommendations are provided for improving the outcome of the thesis.

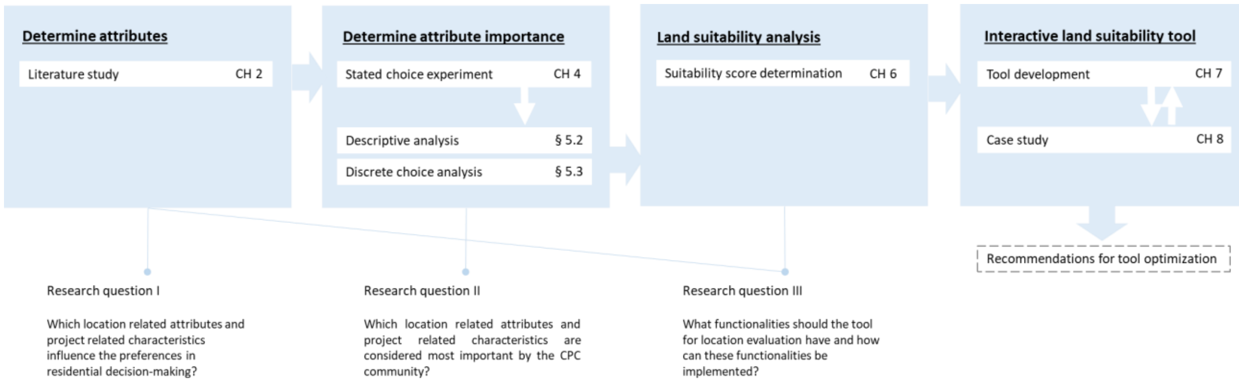

Figure 1: Research design

1.3.1. Scope

This study will be performed in The Netherlands. Data will be collected and analysed from residents living in areas of different urbanity degrees, ranging from the countryside to large city centres, with various socio-economic characteristics and with different views or levels of experience with CPC projects. The land suitability analysis and application of the tool will be limited to the province Noord-Brabant.

1.3.2. Literature study

The research will start with a literature study. This literature study will (fully) contribute to answering research questions I and III. The goal of the literature study is to better understand the concept of CPC projects and to identify what location attributes are deemed in important in residential decision making. The identified location attributes will be used in the land suitability analysis and tool development.

1.3.3. Stated choice experiment

A stated choice experiment (SCE) will be conducted to collect data that specifically serves the topic of this study. Conducting a SCE is necessary since there is no data present available regarding the attributes that influence the location preferences of people interested in CPC projects. The identified attributes and project characteristics in the literature study will be used to structure the experiment.

1.3.4. Analysis

A discrete choice analysis consisting of a multinomial logit (MNL) and latent class (LC) model will be used to determine the weights of the attributes that influence the location preferences of the CPC community. The discrete choice analysis will quantify the preferences regarding residential location decision making. Both the attributes and their weights will be used in the land suitability analysis. Furthermore, a descriptive analysis will identify other CPC project characteristics that influence the residential location decision making. The results of these analyses are used to answer research question II.

1.3.5. Land suitability analysis and -tool

A land suitability analysis will investigate the suitability levels of locations within the scope of the research. This will be done with the use of GIS software and a weighted linear combination (WLC) approach. This results in a map based overview. This overview can help to identify what plots are suitable for CPC development projects, what the suitability levels are for these plots and what plots can be considered most suitable. In the analysis, only the attributes weights identified in the discrete choice analysis will be used. The outcome of the suitability analysis will form the basis for the development of an interactive suitability tool. In this tool, users are able to change what attributes to include and how important they rate these attributes.

1.4. Practical, social and scientific importance

The social contribution of this paper can be found in providing insights of the locational decision making of the CPC community and provide them with a digital tool to help them identify suitable locations for their CPC development. Helping the initiators and future residents of CPC projects with a digital tool for finding suitable locations can help society by contributing to solving the current housing crisis. CPC projects could help in this crisis as it is a means for building more suitable dwellings faster, at a better price-to-quality ratio and more sustainably. Practically, this tool can help to create a structure in the process of location identification for these projects. This could positively affect the amount of time necessary to identify whether there is a suitable location available within the preferred area, and if multiple locations are found, to select the most suitable option. This may help reducing (time) costs and efforts made by the CPC group and the governmental bodies involved, as well as increase the match between demand and supply regarding housing.

Current literature is lacking in knowledge regarding the application of CPC projects. At the moment, the only CPC related literature focuses on investigating the social aspects and benefits of CPC projects. However, no literature exists that identifies the residential decision making motives of people living or wishing to live in CPC projects. This also means that no literature is currently available that investigates the locational decision making of the CPC community. As of now, it is not known what people with interest or experience in CPC find important location attributes or what other factors drive them in choosing a location for development. This study hopes to fill that gap in the literature by acquiring tailor-made data and analyzing it. Also at the moment, there is no tool (publicly) available that helps people interested in CPC projects with their process. In that regard, the developed tool in this thesis will be the first of its kind.

1.5. Reading guide

The following chapter in this thesis is the literature study. In this literature study the importance of location attributes in residential decision making can be found , as well as how the levels of importance may vary across e.g. socio-demographic characteristics. Chapter 3 provides information on what methods are used in the remainder of the study. Chapter 4 explains the process of acquiring data through a stated choice experiment. This data is analysed in chapter 5 by use of a descriptive and discrete choice analysis. The results of these analyses are used to identify suitable locations for CPC development as described in chapter 6. However, not all users have similar preferences of attributes in location decision making. Therefore, chapter 7 provides information on the development of the location suitability tool that allows users to change what attributes they want to include in their search. Chapter 8 documents the process of a case study that uses the developed tool. This thesis is concluded in chapter 9, where the research questions are answered, the strengths and relevance of the thesis are highlighted and recommendations are given on how to improve or use the outcome of the analyses and developed tool.

2. Literature

The literature review is structured according to the two research sub-questions for which the answer can be found or stem from existing literature. The (CPC) project characteristics are identified and all relevant location related attributes in residential decision making are identified. The preferences of the CPC community on these attributes may vary based on personal characteristics. Therefore, the influence of various personal characteristics on location preferences are included in the literature. Also literature is investigated that has identified suitable locations based on location related attributes. The literature study ends with a conclusion of what project and location related attributes will be used in the remainder of this thesis.

It is important to consider literature that is up to date to the current situation. Therefore, only literature is included that was published in the years 2012 till present. Only studies in English and Dutch are included. It is important that the results from existing literature can be applicable to The Netherlands. Therefore, this literature analysis only includes research done in Western countries excluding Japan and Indonesia. This means that all studies are included from all countries in Europe (except Turkey), North America (Canada and the US) and Oceania (New-Zealand and Australia). Finally, only literature that has three or more citations are included in the literature review. In total, six different Scopus searches are performed. This resulted in a total of 2550 records identified in Scopus, of which 578 records are screened based on their titles, 286 records are screened based on the abstracts and ultimately 112 records are included in the literature review. The screening process for every section can be found in appendix A.

2.1. Collective private commissioning: characteristics and (dis)advantages

In this part of the literature review, the focus is to fully understand the concept of collective private commissioning. In this section, first, a short recap of the history of CPC projects is given, followed by relevant definitions of CPC projects, its characteristics, (dis)advantages, stakeholders and general process. The differences between CPC projects and standard construction projects are identified as well.

History

During the mid-1800s, the first forms of CPC were founded during the first industrial revolution, striving for an improvement of 'common life destiny', without violent disruption of society. During this period only a few dozen dwellings a year were created. In the beginning of the 1900s, the government funded or initiated "woningcorporaties", which accounted for nearly 15% of total construction in the Netherlands until the second World War. After WWII, the government was the main contributor of developing new dwelling stock, building 100 000 dwellings a year in its high tide. Later, more bureaucratic rules reduced the number of dwellings built per year. The construction sector, new rules and professionalization alienated the "woningcorporaties" from the inhabitants. Fast forward, in November 2000, the Dutch government accepted a motion that stimulated the realization of (collective) private commissioning, especially for lower income households. The ambition was that 1/3th of the dwellings constructed between 2005-2010 would be (C)PC developments. However, this ambition was not met and the share of (C)PC in Dutch construction dropped from 17% in 1995 to 10-11% in 2005-2009 (Boelens et al., 2010). In the past years, the interest in CPC developments has increased again due to concerns regarding sustainability, the lack of (affordable) housing and loneliness among the increasing number of elder people. This concern is now acknowledged, as several provinces (e.g. Noord-Brabant) are more eager to stimulate CPC developments by offering subsidies (Province Noord-Brabant, 2023).

Definitions

There have been several forms and terms used for collective living in The Netherlands. There is the 'woongenootschap', in which residents join a cooperation or cooperative and gain a share in the residential project without the cooperative losing ownership of the dwellings. 'Centraal Wonen' (freely translated: central living) refers to living around central facilities to relieve the burden of housekeeping and was primarily initiated for emancipating women in the households. Another form is cohousing in which inhabitants share housing facilities such as the kitchen or bathroom. (De Vos & Spoormans, 2022).

Collective private commissioning (CPC) on the other hand differentiates from these forms of collective living since it does not only focus on living, but also on the development of the dwellings. CPC can be defined as a collective form of living where the buyer and his/her future neighbors collectively form an association or foundation to develop their future dwellings. In this association the CPC group has the power to make decision on how to design, build and use the developed dwellings (Bouwen in Eigen Beheer, 2023). CPC projects can be identified as a form of social project development, in which participants can act as initiator, project developer and future user. Besides CPC, also private commissioning (PC) exists, where the main difference is that only one individual decides to develop a home only for her- or himself. Groeneveld (2018) explained that CPC is more of a building method than a way of living, as the level of co-living in such projects vary per project and are often not known prior to the project. CPC development is an interesting development method for all groups in society. However, due to the state of the current Dutch housing supply, CPC projects are especially interesting for seniors and starters. The target groups of CPC projects can thus be categorized into starters, seniors and other groups (e.g. families). CPC projects can also be categorized into projects initiated out of sustainability perspective and projects with or without shared facilities.

Within the concept of CPC, there are several niches, which are often based on the prime initiator. One common niche in CPC development is called 'communal living 50 plus', which is collectively called the 'Landelijke Vereniging Gemeenschappelijk wonen van Ouderen' (LVGO), translating to nationwide association of communal living for elderly. This is a civilian initiative that supports CPC groups of people ages 50 and older. The association supports these CPC groups in their group process, e.g. by providing information, offering legal advice and help solve differences in opinion. The CPC groups that seek help from the LVGO will develop and live in dwellings that allow them to live independently and with shared facilities. Advantages are not only the increased level of independence, but also increased levels of (neighbor) support, shared care and activities, social contact and sense of security (LVGO, 2023) .

Characteristics and (dis)advantages of CPC

CPC projects can differ based on numerous characteristics, such as the year of completion, size of the development, socio-demographics within the group and scale of finances. Regarding size of the development and number of units built, there is quite a range. CPC developments can range from five or six units up till one hundred units (Bouwen in Eigen Beheer, 2023; Eigenbouw, 2014). In smaller projects the downside is that financial gains are smaller due to the economies of scale, while the building process often takes less time. Also, smaller co-housing projects often result in more specific and individual-based private spaces, while larger projects tend to make more concessions leading to more generic designs (Monton, Reyes & Alcover, 2022). Larger developments were found to include a wider variety of collective spaces. The average CPC project is found to develop 10-20 units (Bouwen in Eigen Beheer, 2023), while the most ideal size is expected to be 20-40 households (Eigenbouw, 2014). The developed dwellings can furthermore become both rental as owner-occupied dwellings (Eigenbouw, 2014), and can be built on municipal land, land owned by a project developer or on individually owned land (Boelens et al., 2010). On average, the total development of projects consists of 1.5 years of developing and one year of building (Bouwen in Eigen Beheer, 2023). A common characteristic of the development process is that future residents often gain collective responsibility (Monton et al., 2022).

As future users develop their own future homes, CPC projects are characterized by an increased control of the design and freedom during the development, ultimately leading to a better match between supply and demand of the local residential real estate market (Bouwen in Eigen Beheer, 2023; Eigenbouw, 2014; van den Berg, van der Wielen, Maussen, & Arentze, 2021) and increased level of future satisfaction (Independer, 2023). How the projects are designed can vary. The presence of communal or collective spaces is not a mandatory prerequisite to be identified as a

CPC project (van den Berg et al., 2021). Further variations can be found regarding the housing types (detached, semidetached, row dwellings or apartments), location on the urban-rural gradient, redevelopment or new built, size of the dwellings and architectural style (Van der Wielen, 2017). These all also depend on the target group of the development, which are also found to vary and can consist of both homogeneous as heterogeneous groups (regarding socio-economics). People interested in CPC project vary in age, ethnicity or nationality, education level, income level and household compositions (Groeneveld, 2018; van den Berg et al., 2021). The reasons for participating in CPC project might vary as well. For example, starters might be interested as they face the problem of affordable dwellings in the housing supply. CPC projects can offer a solution as they are found to have a better price-to-quality ratio than common residential projects, as buildings can be bought at development cost (Bouwen in Eigen Beheer, 2023; Groeneveld, 2018). Also a lot of energy and time can be saved, since the project is a joint cooperation between users, which means that necessary solutions can be built on the shared knowledge of more people (Independer, 2023). In general, dwellings developed by realization of CPC projects costs 10-25% less than similar dwellings (Bouwen in Eigen Beheer, 2023; Eigenbouw, 2014). Other reasons can be based on the level of freedom and control, sustainability ideologies or care from the community (Van den Berg et al., 2021). Furthermore, CPC projects are found to increase the level of social cohesion and relations amongst people (Eigenbouw, 2014; Groeneveld, 2018; Monton et al., 2022; Van den Berg et al., 2021; Van der Wielen, 2017), which can also be a reason for participation (Van den Berg et al., 2021).

Participants of CPC projects are more likely to develop collaborative lifestyles in which they have more frequent contact with each other, can provide assistance when needed and can undertake more joint activities (Van den Berg et al., 2021). Especially for older generations that might face loneliness or independence problems, these are serious added benefits. The level of these collaborative lifestyles are affected by the level of effort to getting to know ones neighbors and homogeneity within the group. Collaborative lifestyles are aided by a higher level of age homogeneity among residents (Van den Berg et al., 2021). Increased levels of social cohesion on the other hand are found to be positively correlated with living with a partner and older age (Van den Berg et al., 2021), as well as an increase in size of the project, collaborative lifestyle, age and household composition homogeneity, involvement in an earlier stage, involvement duration, date of completion and presence of common facilities (Van der Wielen, 2017). Ethnicity or income related forms of homogeneity had no influence on social cohesion. Regarding neighbor support, it was found that a collaborative lifestyle, getting to know your neighbors in an early stage, being involved in a larger project group and presence of a supermarket within one kilometer can have a positive effect (Van den Berg et al., 2021). Other neighborhood facilities had no significant association, while household density had a positive relation with neighbor support (Van der Wielen, 2017). Getting to know your neighbors can be promoted by organizing meetings, workshops and neighborhood barbeques (Bouwen in Eigen Beheer, 2023). Another advantage of CPC projects is that they are in general built in a sustainable way, whether it be initiated by the CPC group themselves or demanded from the municipality to acquire subsidies. This can be translated to the implementation of energy-efficient techniques, solar panels and contribution to biodiversity (Groeneveld, 2018)

CPC projects are not only advantageous to future residents, but also for the surrounding neighborhood. Due to the presence of communal facilities, which can be used by both residents as non-residents, communities tend to improve social interaction and increase solidarity (Monton et al., 2022). Neighborhood involvement can also be strengthened by participating in collective maintenance activities, especially in cases of redevelopment or transformation (Eigenbouw, 2014). For the municipality, an advantage is that CPC projects can help reaching policy goals regarding housing for vulnerable groups or for groups for which the housing market is lacking (Eigenbouw, 2014), while the benefits of longer continuation of independent living and a reduced sense of loneliness can help reach government goals concerning these issues. Therefore, bodies of government have created a specific budget for combatting loneliness and extending independent living (Rijksoverheid, n.d.).

There are however also disadvantages to CPC. First, participants may experience quite some uncertainty during the initiation phase of the project, both regarding time and finances (Bouwen in Eigen Beheer, 2023). Second, CPC projects and its potential depend on the willingness to cooperate of the municipality and the number of available, suitable locations (Netherlands Enterprise Ageny, 2019). However, recently more municipalities and provinces stimulate CPC projects by offering subsidies, loans and financial security (Netherlands Enterprise Ageny (RVO), n.d.; Province Noord-Brabant, 2023). A third disadvantage is that a lot of prior work and costs have to be done by the CPC members, where usually this will be done by the developer. The collective decision making also requires compromises within the group, where the groups' interest should always be favoured over the wishes of the individual (Independer, 2023).

Stakeholders

In the CPC development type, there are several stakeholders involved during the initiation, design and development stages. The most important stakeholder is the collective of future residents. Tasks of the CPC group are to unite as one legal entity, make sure there is enough interest of residents, make collective decisions regarding design, delegate tasks, develop a tender or building team and take care of all individual paperwork (Eigenbouw, 2014). These tasks should be carried out with full transparency and a bottoms-up approach. The entity of people must also make sure all the finances are in order, and whenever necessary, find a party to guarantee for the (initial) finances. To smoothen the process, often a (committee) board is necessary to make firm decisions. Motives for participation can vary and include motives out of sustainable living perspective, out of independent living perspective (mediors and seniors) or to create affordable dwellings that are lacking on the current housing market (e.g. starters).

The formation of the CPC group can be divided in two parts. First, during the initiation phase, a smaller group initiates the project and organizes how the development takes place and what all specific will be. Second, during the definition phase, a legal entity will be created consisting of a president, secretary, treasurer and other members. This group will organize daily activities, coordinate the process and act as contact person for all involved parties. Furthermore, there are 'work-groups' in which active members take care of matters regarding the content of the project. They acquire all information and make (collective) decisions such as the tender choice of the architect and constructor. All individuals in the group (thus not only the active members) are part of the legal entity and need to make sure that their needs and wishes are heard. (Geboers, 2008) The municipality can have several roles in the development process. One of the most common roles of the municipality is that they can act as the owner of the building or plot in which the CPC development takes place (De Vos & Spoormans, 2022). As such, they can decide whether or not a CPC development can take place at a specific location. Other tasks of the municipality could be to configure a list of requirements, act as initiating party, meet and support the CPC group, and oversees permits and building codes (Eigenbouw, 2014). Prior to the project, the municipality has to consider a number of things (Eigenbouw, 2014). First, they must have a vision of why they want to develop a CPC project, which often relates to hosting the needs of vulnerable groups on the housing market (Boelens et al., 2010). Sometimes they have to make a selection of candidates. They have to find answers to several important questions. To what extend do they want to gain control, and how strict do the people need adhere to the given norms and rules set by the municipality? Does the municipality wants to focus on new built, infill development or redevelopment? For example, both the province of Noord-Brabant as the municipality 's-Hertogenbosch have a special focus on the redevelopment and infill development of dwellings. Also, the municipality can offer discounts on land in exchange for a sustainable and socially important development. In order to be transparent and have a fluent development process, the municipality is expected to provide a healthy communication mix, consisting of a website containing all information (regarding location, criteria, costs and planning), advertisements, information meetings, excursions to existing cases and attention in the media (SEV, 2007).

Often for a CPC community, there is an advisory party. They support the CPC group since often CPC participants have no or limited knowledge of the construction process. Sometimes, such an advising company is a mandatory requirement of the municipality (Bouwen in Eigen Beheer, 2023). Without their guidance, coordinating the project could become nearly impossible for the CPC group. Possible consequences can be harmful for the municipality (Eigenbouw, 2014). An advisory party is defined by Van der Wielen (2017) as the project coordinator. According to Van der Wielen (2017), this party has several tasks towards the CPC group, including: a) transfer knowledge and hire external knowledge when necessary, b) provide support, guidance and contact with all other parties, c) provide support of setting the program of requirements and legal entity, d) provide support during the recruitment campaign, e) in the decision making structure, f) in arranging financial backstop, g) in developing the design and its specifications, h) in negotiating with other partiers, i) in tax and financial issues, and finally j) warn for potential threats and pitfalls.

Next, there is the architect. The role of the architect is to make a formal design, which should be based on the opinions and wishes of the future residents (De Vos & Spoormans, 2022; Monton et al., 2022; Van der Wielen, 2017). The (joint) design should meet their needs and preferences wherever possible, which can be expressed through collective workshops. In some exceptional situations, architects can also become future residents (De Vos & Spoormans, 2022).

Another party, even though slightly less important, is the contractor. This is the entity that will actually build all dwellings. Their role does not differ from traditional development projects. The advantages for contractors of working CPC projects, is that the sales risks are minimized as the future residents are already known (Bouwen in Eigen Beheer, 2023). Another benefit of this is that they save time, money and effort as there is no marketing campaign for the dwellings. Finally, the revenue per dwelling is higher due to higher customization of both dwellings as shared facilities. (Van den Ham & Keers, 2010)

An overview of all parties involved in CPC development can be found in table 1, which was created by Van den Ham & Keers (2010), after which Van der Wielen (2017) included the 'initiator' and 'pre-development financer'. Here, the differences in stakeholders are highlighted in italic.

Table 1: Overview stakeholders CPO development (Van den Ham & Keers, 2010; Van der Wielen, 2017)

Role	Stakeholder (traditional)	Stakeholder (CPC)
Initiator	Private individual Municipality Architect Housing association Project developer Developing contractor *Investor*	Private individual *Collective of individuals* Municipality Architect Housing association Project developer Developing contractor *Process coordinator / advisor*
Legislator and allocator	Municipality	Municipality *Developing contractor*
Client (in possession of resources and ground)	*Developer* *Investor* *Housing association*	*Private individual* *Collective of individuals*
Pre-development financer	-	*Province / municipality* *Process coordinator / advisor* *Architect* *Housing association* *Project developer* *Developing contractor*
Process guiding and backstop	-	*Process coordinator / advisor* *Coordinating developer, contractor or architect* *Housing association*
Design	Architect (Catalog) Constructor Cost expert	Architect (Catalog) Constructor Cost expert
Construction	(Sub)Contractor Supplier	(Sub)Contractor Supplier
User	Building owner(s) Future residents	Future residents

Process

The collective private commissioning development can be divided into five phases (Van der Wielen, 2017). These phases are the initiation-, definition-, design-, construction- and residential management phases. First, the initiation phase can be started by a multitude of stakeholders, among which are the future residents, advising company or municipality (see table 2). The program of principles and a suitable location need to be identified in this phase. During this phase, private individuals should also be recruited as future residents. This task will be continued also during the second phase, the definition phase. During the definition phase the legal entity will be created (also known as the association or foundation) which need to define the program of requirements. In the third phase, the design phase, the collective will design all dwellings, environment and shared facilities (if present) in close cooperation with the hired architect. In the construction phase the hired contractor starts the actual building process according to all specifications and agreements previously set up. Once this project is completed and delivered, the fifth and final phase starts, the residential management phase. All these phases, the activities necessary and their outcomes can be seen in table 2, which was built by Van der Wielen (2017).

In this study, the focus will primarily be on the first stage of the development process: the initiation stage, since during this stage the location for development needs to be identified. This location identification and underlying motives are the area of interest in this research. During the initiation stage the future residents (initiators), municipality (land-owner) and advising company (guidance) are the most important stakeholders since they determine whether a CPC project is feasible or not.

During the first three phases, a permit needs to be collected at the municipality. The costs that occurred during these phases are related to advice, guidance, meeting costs and ground reservation. Often, these finances are paid for by the future residents themselves, which could be a problem for people with less savings (Eigenbouw, 2014). In such situations, costs could be reduced as some provinces offer subsidies or (zero interest) loans. This received increased attention in recent years, as the number of affordable dwellings in The Netherlands has decreased due to rising prices and lack of construction. Furthermore, additional subsidies and loans could be given to stimulate independent living and tackle loneliness (RVO, 2019).

Along the process, future residents meet (on average) once every three weeks (Van den Berg et al., 2021). As stated before, the earlier and more residents interact with each other, the higher the future level of social cohesion. Such meetings can be formal meetings, presentations, workshops, site visits and more. Furthermore, financing of CPC projects needs to be completely transparent and should be divided into land costs, building costs and development costs (Bouwen in Eigen Beheer, 2023). These costs make up the total house costs of the individuals.

Table 2: Overview CPC process (Van der Wielen, 2017)

Phase	Activities	Outcomes
Initiation	Taking initiative Defining program of principles Search for process coordinator Recruit individuals Contact the municipality Search for location *Inventory of financial capabilities*	Collective of individuals (unfinished) Program of principles Concrete location prospect *Agreement with process coordinator / advisor*
Definition	Setting up legal entity Defining program of requirements Search for architect Agree on location Search for backstop *Continue recruitment of individuals*	Program of requirements Collective as legal entity Ground agreement Architect agreement *Backstop agreement*
Design	Design dwelling, surroundings and collective spaces Assess feasibility Choose plot/dwelling per individual Search for contractor Arrange environmental permit *Arrange funding*	Draft-, preliminary- and final design Technical execution Environmental permit Construction agreement Funding agreement Plot agreement Delivery of plot
Construction	Build dwellings, surroundings and collective spaces Control execution of project *Control delivery of project*	Delivery of complete project
Residential / management	Eliminate or convert legal entity Use dwellings *Manage and maintain dwellings, surroundings and collective spaces*	*Occupation and management*

In the paper by Geboers (2008), the main differences between CPC development and traditional development can be found. First, traditional development has a program based approach, in which the municipal vision and long term policy must be respected. CPC developments on the other hand are more project based. Second, traditional development often occurs with a top-down approach where the future user will only be involved in the last phase of development, while in CPC a bottoms-up approach is used where future residents are included in the decision making across the whole development process. A major difference is the ambiguity of having future residents, which is much higher for traditional developments causing risks regarding financing. Finance is also the concern in the third difference. In CPC developments, municipalities can be assured that once the development is started it will be finished as the financial risk for inhabitants is much larger than for development companies, which more easily pull the plug if the project is found to be financially infeasible. Fourth, during the initiation phase, if the municipality is the initiating party the manner of selecting partners is different. Where in traditional developments often a tender is used, by owning land or by selection, while CPC members are often found through websites, information gatherings or advertising campaigns. Fifth, in CPC development there is much less room for negotiation with the municipality, as the municipality often owns the land and has a stronger position of power. Sixth and final, during CPC projects the municipality more often provides financial support through revolving funds, subsidies or discount ground prices, while in traditional development financial support will only (and not always) be given for social development or in gentrification projects.

2.2. Location and residential decision making

In this part of the literature study, the focus will be on the influence of location related attributes on residential decision making. Factors that influence the residential decision making of people are heterogeneously distributed among society, and can partly be explained by the different stages of one's lifecycle (Andersson, Abramsson, & Malmberg, 2019; Cockx & Canters, 2020; Fatm et al., 2017; Lawton, Murphy, & Redmond, 2013; Liao, Farber, & Ewing, 2015; Smith & Olaru, 2013; Y. Wang, Lee, & Greenlee, 2021). Residential location changes can be e.g. due to retirement, loss of a partner, declining health, marriage, divorce or birth of a child among others. These various stages have an influence of an individuals' requirements regarding space (Lawton et al., 2013), other dwelling characteristics and location related attributes (Cockx & Canters, 2020). These are all found to influence the choice of residential location (Smith & Olaru, 2013) since they affect the residential property value (Coffee, Lockwood, Rossini, Niyonsenga, & McGreal, 2020; Jafari & Akhavian, 2019), which in turn affects attractivity for residences. Schirmer, van Eggermond, & Axhausen (2014) proved that an increase in price has a negative effect on the residential attractivity.

The location of a dwelling is an important factor, as it affects employment and economic development, social structures, spatial segregation and the transportation system (Schirmer et al., 2014). This study found that the location related attributes can relate to the built environment, socio-economic environment, points of interest (e.g. city centers) and accessibility levels. Coffee et al. (2020) divided the location attributes into composition measures (income, education, occupation of individuals or in a wider context) or into context, which they defined as the proximity to various facilities and services such as shops, medical, educational, natural or work facilities. Regarding these facilities, various studies have been performed to investigate how preferences of residential location are affected by both the composition as context.

First, it was found that the ethnic composition (Ibraimovic & Hess, 2018) in an area affects the residential location choice. However, also other socio-economic characteristics affect residential location choice, such as age and household composition. It is found that people tend to choose to reside in areas in which people with similar socio-demographic characteristics live (Lee, Circella, Mokhtarian, & Guhathakurta, 2019; van Gent, Das, & Musterd, 2019). The higher the share of one's 'own group', the higher the residential satisfaction, thus resulting in a lower probability of moving to another location.

Second, it is found that people prefer to live in a clean (R. Wang, 2018), safe and secure environment (Allen, 2015; Kamruzzaman et al., 2013; R. Wang, 2018; Yan, 2020). Third, it is found that accessibility is a key determinant of residential property prices and decision making (Baraklianos et al., 2020; Heldt, Gade, & Heinrichs, 2016; Yan, 2020). This accessibility can be related to access to transportation, social, cultural or environmental facilities. Considering transportation facilities, Kamruzzaman et al. (2013) found that the presence of pedestrian facilities, the lay-out of street networks and access to public transport services affect individuals' residential location choice. The importance of walkability (Liao et al., 2015; Yan, 2020) and accessibility to public transport (Sterzer, 2017; Y. Wang et al., 2021; Yan, 2020) was also found by other studies. Liu & Shi (2017) also found that a higher quality of a dense cycling facilities network positively contributes to the value of residential property, while Liao et al. (2015) found that parking availability is preferred. Regarding social quality of the location, Allen (2015) found that proximity to work, friends and family is often mentioned as a factor in residential location choice. The proximity to work is also found to be an important factor by other studies (Hamid et al., 2012; R. Wang, 2018; Y. Wang et al., 2021). Even though Liu & Shi (2017) found that proximity to the central business district is important, Hamid et al. (2012) found the opposite, and stated that locations further away from the central districts can be equally attractive as long as there are plenty of accessible job opportunities nearby. Other social and cultural aspects that were deemed important included the proximity or access to educational facilities (Hamid et al., 2012; Liu & Shi, 2017; R. Wang, 2018), the proximity to shops and grocery stores (Jafari & Akhavian, 2019; Kamruzzaman et al., 2013; R. Wang, 2018) and to health, religious (R. Wang, 2018) or recreational facilities (Hamid et al., 2012). Furthermore, Wang et al. (2021) found that not only proximity, but also the density of commercial, social and cultural facilities is highly valued by residents. Finally, it is also found that residents care for a residential location with close proximity to environmental facilities, such as parks and other types of greenery (Daams & Sijtsma, 2017; Jafari & Akhavian, 2019; Schaeffer et al., 2016).

2.3. Socio-demographics and residential location preferences

In the previous section is found that location related attributes that influence residential decision making include the socio-economic composition of a neighborhood, a clean, safe environment and the accessibility to transportation, social, cultural and environmental facilities. An overview of all found location attributes that influence residential decision making can be seen in appendix B. Residential decision making can furthermore partly be explained by the different stages an individual goes through in one's lifecycle, such as retirement, marriage or birth of a child. Therefore, it can be derived that for different ages, household compositions and levels of income, the residential location preferences can differ. Also other socio-economic characteristics can affect the residential decision making of individuals, such as the ethnicity or gender of an individual. In this part of the literature review, different preferences identified in literature are explored based on socio-demographic characteristics. This is important, since people interested in CPC project may vary in age, ethnicity or nationality, education level, income level and household compositions (Groeneveld, 2018; van den Berg et al., 2021). In general, Cockx & Canters (2020) found that the socio-economic characteristics, attitudes and environmental awareness of households all influence residential location preferences.

Age

Andersson et al. (2019) found that age is the most important socio-economic determinant of housing preferences. The literature mainly focused on the residential preferences of younger and older adults. Younger adults were often identified at ages of under 35 years. These adults were found to prefer more compact locations that are centrally located (Lawton et al., 2013; Patterson, Saddier, Rezaei, & Manaugh, 2014; Y. Wang et al., 2021), which can often be found in urban locations that are in proximity of public transportation services (J De Vos & Alemi, 2020; Heider, 2019; S. Li, Juhász-Horváth, Harrison, Pintér, & Rounsevell, 2016). A possible explanation for this is that younger adults aim to reduce the costs of owning private vehicles. Also the convenience of having social, cultural or employment facilities in the vicinity was identified as an explanation (Opit, Witten, & Kearns, 2020).

On the other side of the spectrum, Mulliner, Riley, & Maliene (2020) found that older people, often indicated at ages of 55 years and older, prefer to live in clean, safe and walkable environments that have close access to cultural facilities and public transportation. However, this does not necessarily mean that older people prefer to live in more rural locations. The literature is contradictory regarding the living location of older inhabitants on the urban-rural gradient. Fontaine, Rounsevell, & Barbette (2014) found that older generations, and especially retirees, tend to live more in the countryside, larger towns or in the urban periphery. However, other literature found that an increasing age resulted in decreasing preferences of living in the periphery or countryside (Abramsson & Andersson, 2016; Swelsen, 2020). The reason for this is that older people prefer to have easy access to a variety of facilities, such as the grocery store, care facilities, parks and public transit (Andersson et al., 2019; Mulliner et al., 2020; Swelsen, 2020), as this would be beneficial for the independence, well-being and physical activity of older inhabitants. In combination with high-density urban locations this would increase both the social interaction and stimulation of older inhabitants (Mulliner et al., 2020). Still, advanced ages would not only prefer to live in urban locations, but also in other central locations and towns as long as the accessibility to facilities is good (S. Li et al., 2016; Mulliner et al., 2020). Andersson et al. (2019) furthermore found that an increase in age (except for ages 55-64) leads to a decrease in preference of having close proximity to public transportation services and environmental facilities. However, contradictory findings are found in the study by Mulliner et al. (2020). They found that older inhabitants highly rated a safe, clean and aesthetic environment, with good access to health-, retail-, food-, recreational-, public transit- and environmental facilities. Furthermore, walkability and high quality environmental conditions (air quality and noise) are important environmental characteristics. The contradicting literature is an indicator that among the older people, there is a large variety in housing preferences, something that has been proven by Andersson et al. (2019). Finally, the presence of environmental facilities in the near vicinity is found to be an important location related attribute for every age group (Stark, 2022).

Household composition
The type of household is also a contributor to the variety in housing location preferences (Cockx & Canters, 2020). The differences in household size can for example impact the preference of type of environmental facilities (Schaeffer et al., 2016). Regarding the preferences of family households, the literature agreed that these households often tend to move or prefer suburban locations characterized by lower population densities (Bhat, Astroza, Bhat, & Nagel, 2016; Booi & Boterman, 2020; J De Vos & Alemi, 2020; Fontaine et al., 2014; Lawton et al., 2013; Liao et al., 2015), as they desire more space that is less expensive and thus easier to buy in said locations. Also, a general consensus is that family households tend to prefer areas that have good access to (high quality) schools (Lawton et al., 2013; Yan, 2020). Furthermore, they tend to prefer to live in socially homogenous neighborhoods that are safe and have easy access to local facilities, leisure and recreational spaces (Lawton et al., 2013), such as neighborhood parks (Y. Wang et al., 2021). Smaller households, such as single households, prefer to live in urban locations with higher population densities and access to employment services (Bhat et al., 2016; Booi & Boterman, 2020; Gaube & Remesch, 2013; Schirmer et al., 2014). This preference has also been found to be correct for couples without children (Booi & Boterman, 2020; Fontaine et al., 2014; Liao et al., 2015; van Gent et al., 2019; Y. Wang et al., 2021) and students (Booi & Boterman, 2020).

Income and education
The education an individual followed was also found to be an indicator of varying residential location preferences (Cockx & Canters, 2020). First, lower educated people tend to reside more in suburban neighborhoods (De Vos & Alemi, 2020), while higher levels of education tend to prefer an urban location irrespective of their household characteristics (Ströbele & Hunziker, 2017; van Gent et al., 2019). This tendency can be explained by the fact that people of higher education have an higher preference of access to a rich supply of cultural facilities, that are most often found in urban locations (Andersson et al., 2019; Van Duijn & Rouwendal, 2013).

Regarding the income level of households, Sterzer (2017) found that lower income households more often have to make concessions regarding their preferred residential location and where they can afford to live. Therefore, they are often forced to reside in suburban areas with less access to facilities (Y. Wang et al., 2021). Still, people with lower income levels were found to reside in locations in proximity of grocery stores and nature (Andersson et al., 2019). People of higher income levels can thus more often afford to live in locations of their preference. Most literature found that this economic group (including dual-income households) prefer locations in proximity of various facilities (Van Gent et al., 2019), e.g. related to employment or shopping facilities that are most often found in urban neighborhoods (Gehrke, Singleton, & Clifton, 2019; Y. Wang et al., 2021). However, no general consensus was found for the influence of income on location on the urban-rural gradient. Various other studies found that higher income groups tend to prefer to live in lower density, safer neighborhoods with access to (higher quality) schools, vegetation and greenery (Ardeshiri & Vij, 2019; Daams & Sijtsma, 2017; Jarass & Heinrichs, 2014; Li et al., 2015; Liao et al., 2015; Yan, 2020) that are more commonly found in rural locations. Additionally, Frenkel, Bendit, & Kaplan (2013) investigated the residential preferences of knowledge workers and found that they prefer to live in high-density, urban environments with a rich supply of cultural and education facilities.

Other socio-economic characteristics

Tenure status and nationality were also found to be contributing factors of residential location choice (Cockx & Canters, 2020). First, it is found that owner-occupants are more sensitive to accessibility attributes than tenants (Inoa, Picard, & de Palma, 2015), and generally have better accessibility to vegetation (X. Li et al., 2015). A possible explanation for the latter is that relatively most dwellings available for owner-occupancy can be found in rural locations, that have closer access to nature and space for street-level greenery. Regarding the nationality, the only significant finding is that people with a migration background are more likely to reside in urban locations than people without a migration background (Booi & Boterman, 2020). Other literature also found relations between background and residential location decision making, but were mainly contributing to the American society. As these studies often differentiated between whites, African-Americans and Latino-Americans, these studies are not included in this literature review as they seemed irrelevant for the Dutch landscape. Finally, gender is also found to be an important characteristics in residential preferences. Women consider proximity to public transportation as more important than men (Andersson et al., 2019; Mulliner et al., 2020), while men prefer parking facilities and proximity to environmental facilities more than women (Andersson et al., 2019). Furthermore, De Vos, Van Acker & Witlox (2016) found that men and higher educated residents prefer rural living, while women and higher income residents prefer urban living.

Level of urbanity

Another consideration is to investigate the differences in preferences of people living in rural and urban locations. Due to their current residential location, they might have different perspectives based on experiences. For example urban residents are found to consider proximity to public transportation facilities more than suburban or rural residents (Andersson et al., 2019; Ströbele & Hunziker, 2017). This configures to the fact that urban residents appreciate their current transportation access, as (Dutch) urban locations of high density are found to have an extensive public transit network and street designs stimulating active mobility, which are allowed by high density and diverse settlements (J De Vos & Witlox, 2016). Furthermore, urban residents tend to prefer and value a close proximity to shops, recreational- and other facilities (J De Vos & Witlox, 2016), possibly since this aids the convenience and ease of living. This was observed in the study by Allen (2015), which further identified food related facilities (supermarkets, cafes and restaurants) as important. Residents of rural locations on the other hand tend to prefer a peaceful and safe neighborhood more than urban residents (Jonas De Vos et al., 2016). They also tend to value cycling facilities, sense of place and cultural heritage values more than urban residents (Elbakidze et al., 2017). Furthermore, they more often reside and prefer environmental facilities (Ströbele & Hunziker, 2017). However, the preference for green landscape elements and water is found to exist for both urban as rural residents (Elbakidze et al., 2017; Ströbele & Hunziker, 2017). Rural residents also consider access to shops, public- and meeting spaces as important, even though they are often lacking in their current neighborhood (Ströbele & Hunziker, 2017). The extent to which preferences for rural relocation are accomplished depends however not only on socio-economic characteristics, but also on current residential location (De Groot, Daalhuizen, van Dam, & Mulder, 2012). Couples are e.g. more likely to realize their rural preferences than singles and households with children, and local movers are more likely to realize their preferences than people that attempt to relocate to other (non-local) residential environments.

Socio-economic characteristics and CPC

One of the characteristics of CPC projects is that there is a great heterogeneity regarding the socio-economic characteristics of the participants, as they range in age, ethnicity, education level, household income and household composition (Van den Ham & Keers, 2010). Furthermore, the composition of CPC groups can vary as well. Some groups develop solely for starters, seniors or out of environmental perspective. On the other hand, some groups could consist out of a combination of these groups, or out of groups that cannot be recognized as either starters, mediors or seniors. Combining the diversity in CPC groups with the influence of various socio-demographics on residential location choice results in the following findings.

In the literature it is found that age is the most important socio-economic characteristic in residential location choice. If a CPC group develops *solely for starters,* they are expected to follow preferences that characterize younger adults (under 35 years). It is found that younger adults prefer more compact and central locations (which are often found in urban areas), while older adults can have contradicting preferences regarding the level of urbanity. On the other hand, CPC groups developing *solely for mediors or seniors* are expected to follow the preferences of older adults. These people attach greater value to a clean and safe environment, with sufficient pedestrian facilities. *Both younger as older adults* agree upon other location related attributes, which are thus expected to be valued by the majority of CPC groups. The majority of CPC groups are expected to favor locations with close proximity to public transport, social, cultural and employment facilities. However, for the retired elderly group in CPC developments, the proximity to employment facilities is not expected to be valued as high, while they could value proximity to care facilities more. Regarding ethnicity, education or income, no divisions can be seen in the most found target groups of CPC developments. CPC groups could be both homogeneous as heterogeneous distributed within a group regarding ethnicity, education- or income levels. However, based on the literature review. CPC groups are expected to prefer urban locations when the group consists of a higher share of non-Dutch participants or participants with higher completed levels of education. Groups of participants of higher income might favor locations in closer proximity to employment or shopping facilities. For this group of participants, it can furthermore be expected that their motive for participation in CPC is not related to the affordability of the developed dwellings. Finally, some CPC projects might be specifically developed *for families*. The literature tells us that these CPC groups would prefer safe, suburban locations with close proximity to schools and parks, while groups without families in their participant composition might value access to employment facilities more. Also, even though the tenure status and gender of an individual might influence residential location decisions, these are not deemed characterizing attributes of CPC participants as no projects have been developed solely for men or women. Furthermore, both owner-occupied as rental houses can be developed in CPC, either distinctively or mixed within a project. Finally, CPC developments can occur in areas with varying urbanity degrees (urban, suburban, rural).

Based on the information provided in this subsection, it is expected that CPC groups developing in urban locations value access to public transport, shops and food related amenities as more important, while groups developing in the rural landscape are expected to value safety and cycling services as more important. The difference in preferences regarding urbanity is expected to play an important role in the location decision making of the CPC community and will thus be included in the stated choice experiment and data analysis.

2.4. Redevelopment projects and residential location preferences

Due to the fact that space is limited for new residential development in The Netherlands and the fact that CPC projects can consist of both redevelopment and new-built projects, the combination of redevelopment projects and location preferences should not be neglected in the literature study. First, Bader (2011) investigated socio-economic differences of people preferring redeveloped neighborhoods. He found that younger respondents (20-40 years old), married respondents and higher educated respondents are more likely to consider redeveloped neighborhoods. Furthermore, he found that one socio-economic characteristic cannot exclusively be compared to redevelopment attitudes. For example, wealthier respondents only prefer redeveloped areas if they reside in urban locations. Younger women are less likely to consider redeveloped areas than younger men and married older respondents are less likely to consider said areas than non-married respondents. Furthermore, Jansen (2014) found that starters on the housing market are more likely to consider redeveloped or transformed buildings over new build. Based on the information provided so far, it is expected that CPC groups with a high share of starters, married (younger) respondents or higher educated (urban-residing) respondents are more likely to engage in redevelopment CPC projects.

Other findings are related to the environmental characteristics of redeveloped buildings. First, Stark (2022) found that people that reside in transformed cultural-historical buildings value proximity to greenery as the most important location related attribute, where also a direct neighborhood and residential diversity was included. Hernandez Quiñones (2017) on the other hand found that considering the redevelopment of vacant buildings into housing, residents preferred besides price and dwelling characteristics, neighborhood attributes such as walkability and proximity to city center as important. The importance of walkability did decrease with an increasing household size. The distance to public transport facilities did not influence the preference of location.

2.5. Locations excluded from development

So far, this literature review has mainly focused on the preferences of individuals regarding dwelling location characteristics. The literature review has found that people with different socio-demographic characteristics might have varying preferences of residential location. However, the location at which a development takes place is not solely based on the preferences of individuals. Perhaps even more important, are the general exclusion criteria for residential locations. The most important reason for exclusion is given by the land use plan: an area or location only permits the development of dwellings if the function on the landuse plan is given as ‘residential’. Despite uncommon, land uses can be altered by the government to make way for new residential development. Therefore, in this study, having a current residential function in the land use plans is not a mandatory attribute of locations in this study. However, some land uses are always considered unsuitable for residential development. The Dutch government wants to strengthen natural areas in the coming years, both in protected nature reserves as spread through the built environment (Rijksoverheid, n.d.-b). Therefore, in this study, locations in nature (e.g. forest, meadows), where there is now water or with various greenery functions (e.g. parks) will always be considered unsuitable locations for residential developments.

Other reasons to exclude certain locations for residential development are based on guidelines regarding air quality, noise nuisance or external safety (IPLO, 2023). New dwellings should only be built in locations in which the safety and health of the residents cannot be negatively affected by its environment. Therefore, no dwellings are advised to be built in close proximity of highways, provincial roads or busy inner roads due to air pollution concerns (AWGL, 2022; IPLO, n.d.-a). The advised minimum distances that should be respected from these infrastructural elements are 150 meters for highways, 50 meters for provincial roads and 25 meters from busy urban roads (AWGL, 2022). Not only are areas near highways excluded for residential development due to air quality concerns, but also due to noise nuisance concerns and the negative effects that stem from them (IPLO, n.d.-c). Also external safety needs to be included in reasons to exclude areas for residential development. In this study, this will be done by excluding areas underneath or in the vicinity of both above-ground power cables as wind turbines. One reason for not building (and living) near power lines is due to concerns that children living near them might have a raised chance of suffering from leukemia (Rijksoverheid, n.d.-c). Areas underneath or surrounding wind turbines are excluded since they are identified as a risk source IPLO (n.d.-b). Furthermore, IPLO (n.d.-b) also identified companies or transportation of dangerous substances, firework deposit and ammunition deposit as risk sources. Finally, also, the cost of the land can be used as an exclusion criteria based on the available budget for CPC development. However, this criteria is not fixed and can thus vary per CPC group.

2.6. Methods to identify locations for development

So far, the literature has identified what CPC project characteristics and location related attributes could influence the residential location decision making. The literature furthermore identified what locations should always be excluded from consideration. It is also important to investigate how previous studies have used similar knowledge to identify suitable locations within their study. In total, 45 studies were used to gather insights regarding methods to identify suitable locations. Almost all found literature based their included attributes on a literature study and have used GIS systems to extract relevant data and identify suitable locations. The literature has different approaches however for determining the importance of the found attributes and the type of data they used. First, it could be seen that the majority of the found literature uses a raster data analysis (n = 42), while only a few (n = 3) performed a suitability analysis on vector data. Furthermore, it could be seen that the majority of the found literature uses an analytic hierarchy process (AHP) to determine the weight of the included criteria. This can be seen in table 3. The AHP method is a form of multi-criteria analysis. The combination of using a multi-criteria analysis and GIS systems can also be called a spatial decision support system (SDSS). A SDSS is an interactive, computer-based system designed to support users in having a higher effectiveness in decision making, while solving a spatial decision problem (Malczewski & Rinner, 2015). Spatial decision support systems combine spatial and non-spatial data. They use the analysis and visualization functions of GIS and decision logic to compute the characteristics of problem solutions, to evaluate solution alternatives and to assess the trade-offs made during the evaluation of the alternatives (Keenan & Jankowski, 2019). In spatial decision support systems, multi criteria decision analysis is the most often used approach (Malczewski & Rinner, 2015).

Table 3: Overview methods for suitability analysis

Method used in suitability analysis (for determining weights)	Literature count	Sources
Analytic Hierarchy Process (AHP)	19	Alam & Dwivedi (2019); Aldababseh et al. (2018); Burian et al. (2018); Chen & Paydar (2012), Delivand et al. (2015); Dell'Ovo et al. (2018); Jeong et al. (2013); Mokarram et al. (2021); Morales & De Vries (2021); Mosadeghi et al. (2015); Paul et al. (2020); Randazzo et al. (2018); Romano et al. (2015); Sallustio et al. (2022); Sultana & Kumar (2012); Sun et al. (2021); Tennakoon et al. (2023); Viccaro et al. (2022); Viccaro et al. (2018)
Analytic Network Process (ANP)	4	Ferretti & Pomarico (2012a, 2012b); Modica et al. (2014); Zabihi et al. (2015)
Logic Scoring of Preferences (LSP)	3	Hatch et al. (2014); Montgomery et al. (2016); Passuello et al. (2012)
Equal weight	3	Amichev et al. (2020); Katkar et al. (2021); Omitaomu et al. (2012)
Expert opinions	3	Montgomery & Dragićević (2016); Pulighe et al. (2016); Sitzia et al. (2014)
Fuzzy rules	1	Feng et al. (2017)
Monte Carlo	2	Ligmann-Zielinska & Jankowski (2014); Saha et al. (2021)
Boolean, logistic or regression	2	Cheng & Thompson (2016); Koomen et al. (2015)
Weighted Sum	1	Rodrigues et al. (2017)
Cohen's *d* criteria weight	1	Addae & Dragicevic (2022)
Weighting Matrix	1	Wang et al. (2016)
Ordered Weight Averaging (OWA)	1	Ferretti & Pomarico (2013)
ELECTRE	1	Silva et al. (2014)
Other	3	Burian et al. (2015); Franco & Magalhães (2022); Passuello et al. (2013)

Spatial decision support systems (SDSS) are not uncommon in environmental studies (Keenan & Jankowski, 2019). In the literature, decision problems often consist of a combination of spatial and non-spatial data. Spatial data includes geographic coordinates and spatial relations such as proximity and distribution patterns (Keenan & Jankowski, 2019). The decision problems in SDSS includes site selection, suitability analyses, resource allocation, networking routing, location allocation and service coverage (Keenan & Jankowski, 2019). The tool in this thesis will be created using a spatial decision support system since it focuses on a suitability analysis. A SDSS allows that the spatial data can be obtained from various sources such as OpenStreetMap and crowdsourced data. SDSS also allows the final result (here: suitability map) to be publically available on websites, route planners, mobile apps and other tools (Keenan & Jankowski, 2019).

Spatial decision support systems that integrate GIS and MCDA use a procedure that transforms the geographic data (maps and input) and the preferences of the target group into a decision map. Integrating these preferences with the data can be done using decision rules that are defined by the chosen decision analysis methods. Before the decision analysis method can be chosen, first, the type of decision rules should be defined. Decision rules can be classified using either a multi-attribute (discrete) model or a multi-objective (continuous) model. Multi-attribute models define criteria by explicit attributes and are mostly used in land use and suitability assessments, while multi-objective models define criteria based on explicit objectives. In this study, the suitability of plots will be assessed and therefore uses a multi-attribute model. In the book by Malczewski & Rinner (2015), the four most popular methods for suitability assessment are identified as the weighted linear combination (WLC) method, the analytic hierarchy and network process (AHP/ANP) method and the ideal points method or outranking methods (ELECTRE or PROMETHEE). The most often used method are the AHP and WLC methods. The WLC method is determined by two components: the weights and the attribute level functions. For every attribute included in the model, different attribute levels could have different weights. The overall suitability score will be the result of a linear, additive formula that adds all individual, attribute related, weights to determine the final score. The most often used approaches in determining the attribute level weights are the pairwise comparison method and the criterion range standardization method (Malczewski & Rinner, 2015). In this thesis however, discrete choice analysis will be used to determine the attribute level weights.

2.7. Conclusion

This literature study has identified what location attributes and (CPC) project characteristics influences the locational decision making. The price, dwelling characteristics and location are the most important factors in residential decision making. Since dwellings characteristics will be valid only once suitable locations are identified, the remainder of the study will only focus on the price of the land and various location related attributes in the analysis. The location related attributes that will be included in this study are related to the density of a location (urbanity level), level of greenery and proximity to (public) transport and grocery facilities. Furthermore, socio-economic characteristics are found to vary in or between CPC groups. Different location preferences can be based on these characteristics. The stated choice experiment and tool will therefore include the age, household composition, income and education level, tenure status, gender and nationality. The influence of the found CPC advantages on locational decision making will also be included in the study and consist of e.g. an increased level of sustainability, affordability and social interaction. Identifying suitable locations for residential development can be done with the use of a spatial decision support system that combines the weighted linear combination (WLC) approach with the application of GIS systems. During the identification of suitable locations, some locations will be excluded based on the landuse plan, while the literature also found that residential development cannot occur within nature, near highways and provincial roads, near power cables and near wind turbines.

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3. Methodology

This study aims to gain understanding of residential location preferences of the CPC community. From the literature can be concluded that location related attributes that influence these preferences are related to socio-demographics and to the built environment and accessibility. It is further found that differences in socio-demographic characteristics have an influence on residential location preferences. Even though hypotheses can be drawn from the literature, no conclusive preferences can be obtained for the CPC community. This chapter explains the methods used for acquiring insights in the relation of CPC with residential location preferences. A tailor-made dataset needs to be created, since none were yet available in the context of collective private commissioning in The Netherlands. An online survey based on stated choice modelling is therefore created and distributed. The gathered data is then analysed. In this chapter, the method for data collection is explained followed by the method for data analysis and the location suitability analysis.

3.1. Stated choice experiment

There are several methods for identifying preferences of individuals regarding housing choices. Timmermans et al. (1994) identified that stated choice or revealed choice modelling are suitable methods for this purpose. The main difference between the two is that stated preferences ask the respondent to choose from an hypothetical set of alternatives, while revealed preferences are based on observed data from the past. Other differences can be found in the method of data collection and model estimation (during the analysis). Stated choice experiments can only be conducted by creating a survey in which participants have to state their preferences, while revealed choices can only be analysed from an existing dataset. Similarities between the two methods exist as well. First, the alternatives can be described and qualified based on a set of attribute levels (Timmermans et al. 1994). Furthermore, both theories are built on the assumption that individuals derive utilities from each of the attribute levels, and that these part-worth utilities can be combined, resulting in an ultimate preference or choice.

A revealed preference study is not an option since no existing dataset existed that could be used in this study. Thus, the method used for the analysis in this study is a stated choice experiment. Gathering data following this method is a quantitative method. In such an experiment the respondent has to choose their preferred alternative from a number of alternatives (Molin, 2014). These alternatives can be described based on the context of the choice and by differing attributes. Context related characteristics are similar for every alternative. The attributes that form the alternatives can however differ based on their attribute levels. The number of alternatives and attribute levels depends on the scope of the study. The choice of most preferred alternative depends on the differences in attribute levels and how the respondent values from them. It is thus assumed that the context does not affect the choice or preference.

Stated choice models for housing preferences can furthermore be divided in two groups: compositional models or decompositional models. In compositional models, preferences are measured by people evaluating housing attributes separately, after which the relative importance of each attribute is measured. Modelling will be done by combining the separate attribute utilities into a model by using an algebraic rule. Modelling is relatively simple and survey questions are easy to interpret: attribute evaluations is done by using rating scales, which are identical for each attribute. Downside of this method is that respondents are not familiar with other attributes that might influence their decision or preference, since respondents do not have to make trade-offs, which is inconsistent with reality, Therefore, this study uses decompositional models for the stated choice modelling, since in this method, correlation between attributes and trade-offs are included. In decompositional models, individuals need to consider a number of alternative profiles, which can be called a choice-set of profiles. A profile consist of a number of attributes, where profiles may vary based on the differences in attribute levels. The higher the number of attributes or attribute levels, the higher the total number of combinations possible. The individual has to consider and choose between a number of attributes, leading to a set of interrelated choices, involving subjective responses including ratings or a best to worst scale. The overall utility can be decomposed into individual utilities for every attribute, hence the name decompositional models. (Hensher, Rose & Greene, 2015; Timmermans et al., 1994)

Setting up the stated choice experiment in this study is done according to the process as identified by Hensher, Rose & Greene (2015). An overview of this process can be seen in figure 2. First, the investigated problem must be made clear, after which the list (and number) of alternatives, their attributes and (the number of) attribute levels need to be determined. The attribute levels can be labelled both quantitatively as qualitatively. During the experimental design consideration, the choice has to be made to use either a full or factorial design, select a coding format, to choose labelled or unlabeled experiments, to select main or interaction effects, the degrees of freedom and to use dummy or effect coding. The choices made for these design considerations then need to be generated into an actual experimental design and attributes need to be allocated to the design columns. Finally the choice sets must be generated and randomized, after which the experiment can be put into the used survey instrument. The application of these steps in this study can be seen in chapter 4.

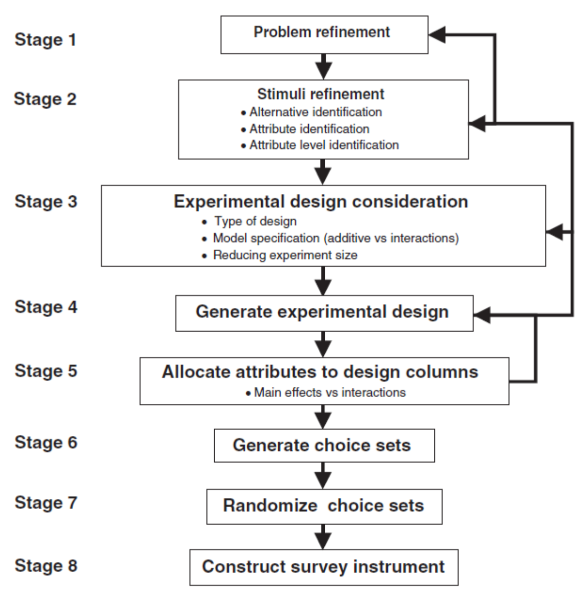

Figure 2: Experimental design process (Hensher et al. (2015))

Decisions have to be made regarding a full fractional design, fractional factorial design or orthogonal design. A full factorial design is a design in which all possible combinations of attributes are used, thus leading to the greatest size of the experiment. In a fractional factorial design only a fraction of the total design will be used. The size of the experiment and following dataset is influenced by the number of attributes and attribute levels. Sometimes there is simply a too large number of possible combinations leading to too many choices to be made by the respondents. Therefore, in this study a fractional factorial design will be used to reduce the size of the experiment. The size of the experiment also depends on whether the experiment is labelled or unlabeled. Labelled experiments use specific titles for the alternatives (e.g. car, bicycle, public transport), while unlabeled experiments use a generic title (e.g. location A, location B). This study uses an unlabeled experiment. (Hensher et al., 2015; Timmermans et al., 1994)

Coding formats can be used in analyses to represent possible combinations by assigning unique numbers to every attribute level. The attribute levels in this SCE can be coded using either dummy coding or effect coding. In dummy coding, every attribute level can be identified by a code of 0 and 1 and every first attribute level has zero impact on the utility. In this SCE, every attribute has three attribute levels. Therefore, in this study, dummy coding would result in attribute level 1 to be coded as 1 – 0, attribute level 2 by 0 – 1 and attribute level 3 by 0 – 0. This study has however followed the advice from Hensher, Rose & Greene (2015) to use effect coding. The advantage of effect coding over dummy coding is that it does not confound the base level of an attribute with the overall mean. Using effect coding on three attribute levels, attribute level 1 would be coded as 1 – 0, attribute level 2 as 0 – 1 and attribute level 3 as -1 - -1. Here, the impact of the first attribute level is opposite to the sum of the other attribute levels (Hu et al., 2022).

In a SCE also a choice has to be made to use either main effects or interaction effects. A main effect is the direct and independent effect of an attribute on the choice made, while an interactive effect is an effect on a choice that is obtained from combining two or more attributes. The degrees of freedom of an experiment can be determined by S * (J-1). Here, S equals the number of choice situations and J is the number of alternatives in each choice situation. Furthermore, the degrees of freedom must be greater or equal to the number of independent constraints or beta parameters (attributes). The sample size of SCE model estimates can be determined by the model type, number of alternatives, number of attributes, number of attribute levels, attribute level range, design itself and the likely parameter estimates. The size of the experiment thus depends on the number of attributes, which also results in a higher necessary number of respondents. It is advised not to exceed the limit of ten independent attributes.

3.2. Discrete choice analysis

In this section, the method for analysing the data is explained. First, the general theory of discrete choice modelling is explained and why it is applicable for the data gathered, followed by the mixed logit model, multinomial logit model and latent class model are explained.

3.2.1. Introduction to discrete choice modelling

There are two research aims in this study: to gain knowledge on the preferences of the CPC community and to create a tool that supports the CPC community in the location identification step for development. For creating the tool, it might be beneficial to derive attribute weights from the analysis. One way of gathering insights regarding the preferences and translating these to attribute weights, is to adopt a discrete choice modelling (DCM) method. In decompositional preference models, utilities of the choice are decomposed into the partial utilities per attribute included. The utility of a choice depends both on the characteristics of the alternatives as on the characteristics of the individual making them. This allows the investigation whether certain personal characteristics influence the choice of alternatives. Concretizing this to the scope of this study: by adopting a DCM method, it is possible to analyse whether personal characteristics (e.g. age, gender or affinity with CPC projects) have an influence on the choice of living location. Estimating the utilities can be done with likelihood estimation, where in general the utility (U) from an individual i making a choice j is the function of the observed features of the choice (Z_j) and an error term representing unobserved attributes of choices and individual (ε_{ij})(Columbia University, 2023). V_{ij} is often used instead of U_{ij} if the structural utility needs to be determined. If the model assumes a linear function, then the researcher can use a linear random utility model::

$$U_{ij} = \sum_k (\beta_k \cdot Z_{j,k}) + \varepsilon_{ij} \tag{1}$$

U_{ij}	Utility of choice j for individual i
β_k	Parameter representing the weight of attribute k
$Z_{j,k}$	Feature of attribute k for choice j
ε_{ij}	Error term of choice j for individual i

The remainder of this section focuses on the use of a multinomial logit model and latent class model, since these will be used for the analysis of the gathered choice data.

3.2.2. Multinomial logit model

The multinomial logit (MNL) model is the base model of discrete choice modelling and the most frequently used in housing preference studies. Therefore, this model deserves attention in this study. This model can be used when the random utility components are assumed to be Gumbel distributed (Train, 2009a). Random utility components (ε_{ij}) are error terms that can be used to represent taste variations, measurement errors and follow some statistical distribution. If the multinomial logit model is used for the determining the structural utility, the formulas for determining the probability p_{ij} that the individual j will choose alternative i can be seen in formulas 2 and 3.

$$p_{ij} = \frac{e^{V_{ij}}}{\Sigma_{i\prime}\, e^{V_{i\prime j}}} \qquad (2)$$

p_{ij} Probability that individual i makes choice j
V_{ij} Structural utility of choice j for individual i

$$V_{ij} = \Sigma_k(\beta_k \cdot Z_{i,j,k}) \qquad (3)$$

B_k Parameter representing the weight of attribute k
$Z_{i,,j,k}$ Score of alternative j on attribute k for individual i

The parameter estimate can then be calculated. The parameter estimate is an attribute specific statistic which indicates if the attribute influences the preference of an individual for a certain alternative. The further from zero, the stronger the preference. Furthermore, the statistic tells whether this influence is positive or negative. If the parameter estimate has a negative value, the individual is less likely to prefer a certain alternative, while a positive value indicates that an individual is more likely to prefer the alternative. The parameter estimates can be determined using the maximum likelihood estimation method. The formula for determining the likelihood is:

$$L(\beta) = \Pi_i \cdot \Pi_j \cdot p_{ij}{}^{y_{ij}} \qquad (4)$$

p_{ij} Probability that individual I makes choice j
y_{ij} 1: choice j was made by individual i
0: otherwise

In this formula, the y_{ij} has a value of 1 if alternative *i* was chosen by individual *j*, while it has a value of 0 if another alternative was chosen. The parameter estimates however are prone to error. The level of this error is given by the standard error (SE) of the coefficient (Hensher et al., 2015). The lower the SE value, the lower the likelihood of the parameter to include errors. Once all parameters have been estimated, the performance of the model can be checked using the goodness-of-fit test. The formula to test the log-likelihood of the estimated parameters can be seen in formula 5.

$$LL(\beta) = ln(L(\beta)) \qquad (5)$$

$LL(\beta)$ Log likelihood
$ln(\cdot)$ Natural logarithm

The log-likelihood (LL) function of a choice model determines the model performance of the estimated model (Hensher et al., 2015). However, only assessing the LL function of one choice model provides no information of the performance of the choice model. The LL function of the choice model must be compared to the LL function of a base (or null) model to gain information of the performance of the choice model. The null model is a model independent of any information that is present in the data. Furthermore, the LL function can be compared to the constants only model, a model fitted that uses "only information on the market shares as they exist within the data set" (Hensher et al., 2015). The closer the statistical value is to 0, the higher the performance of the estimated model. If the estimated choice model performs better than the base model (the LL function of the estimated choice model has a value closer to 0), the estimated model has an acceptable model performance.

The goodness-of-fit of the model can be determined using the formula expressed below, explaining the pseudo Rho^2. According to Hensher et al. (2015), a value of between 0.2 and 0.4 for the Rho^2 represents an adequate model-fit for the choice model. It is also possible that there is a Rho^2-adjusted statistic. The difference between this statistic and the "normal" Rho^2 statistic, is that the adjusted statistics accounts for the number of parameters in the model.

$$\rho^2 = 1.0 - [LL(\beta) \mathbin{/} LL(0)] \tag{6}$$

LL(β) Log likelihood using estimated parameters
LL(0) Log likelihood using null model

This formula for the goodness-of-fit can also be adjusted so it incorporates the total number of choice alternatives N_{alt} and the number of parameters in the model N_{par}.:

$$\rho^2{}_{adjusted} = 1.0 - [N_{alt} \mathbin{/} (N_{alt} - N_{par})] \cdot [1.0 - \rho^2] \tag{7}$$

N_{alt} Total number of choice alternatives
N_{par} Number of parameters in the model

The MNL model can also be used to determine the willingness-to-pay of certain groups. Also in this study, the willingness-to-pay can be used as an explanatory element, as the price of the land is one of the attributes characterizing the location. It can be determined how a change of X meters closer to a supermarket may affect the price that the respondent is willing to pay. A downside of the MNL model is that it does not take heterogeneity into account. Advantages of the MNL method however, are that it is relatively easy to use and that it can be used to estimate in cases when many alternatives exist.

3.2.3. Latent class model

The Latent Class (LC) model can be used to find classes of individuals with similar preferences. It builds further on formula 3, as classes can be identified by searching for individuals with similar sets of own parameters, which are called added random components (Train, 2009b). Each class of individuals has similar parameter values and can be represented by similar personal characteristics (age, gender etc.) or experience with CPC (no experience, initiating experience, completed experience). To include classes with similar preferences, the structural utility formula for the latent class model can be seen in formula 8.

$$V_{i,j \in Class_c} = \beta_{1c}Z_{i1,j} + \beta_{2c}Z_{i2,j} + \beta_{3c}Z_{i3,j} + \beta_{4c}Z_{i4,j} + \beta_{5c}Z_{i5,j} + \beta_{6c}Z_{i6,j} + \beta_{7c}Z_{i7,j} \quad (8)$$

c class 1, 2 … C
C Number of classes (cluster of individuals)
β_{1c} Parameter representing the weight of attribute *1* for class c

For every individual *i*, the probability of belonging to a certain class *c* can be computed, where ultimately, the sum of probabilities to all classes per individual should be equal to 1. The probability of belonging to a certain class can be predicted by the latent class model as well, based on the personal characteristics available in the data.

Performing the MNL model and LC models for this study is done with the use of software system NLOGIT (Economics Software Inc., 2012).

3.3. Suitability assessment

The suitability levels of locations can be determined with a suitability assessment. This assessment can be divided into two stages. First, general exclusion criteria should be applied. If the general exclusion criteria are met, it means that a plot finds itself in a location which can never be considered for residential development and are thus withdrawn from the suitability assessment. The second stage is to evaluate the suitability of the remaining locations for CPC development. In the suitability evaluation, several steps need to be taken: to determine the area of interest, to determine the type of data (vector or raster), to obtain the base layer, to attach relevant location attribute information to the base layer and to determine the suitability level based on the attribute information. In this suitability evaluation, vector data is used since the suitability map should be based on data contents as it should allow interactively working with the suitability map. The base layer consists of all plots suitable for residential development. The suitability score will be calculated using a weighted linear combination (WLC) approach, as described in section 2.6. The suitability assessment will be done using geographic information systems (GIS). In GIS systems, the geographic position of locations and relevant geospatial data can be gathered and manipulated. For the steps using GIS, the QGIS software was used. This software is used since the author had more experience with this software during his studies. This section will now further explain the methods for conducting the suitability assessment based on the two stages.

3.3.1. General exclusion criteria

All locations for plots that were considered unsuitable for residential development, irrelevant of the preferences of the target group, need to be removed from consideration. This act is called the general exclusion assessment. Later, in the tool development, also a personal exclusion assessment is performed to remove unsuitable locations for development that are solely based on the preferences of the target group. For now, the focus was on the general exclusion assessment. Performing the general exclusion assessment meant that all plots considered impossible for residential development to occur needed to be removed from the original dataset. The base layer in this assessment was a vector data layer consisting of the municipal land uses (Dutch: enkelbestemmingen). Most general exclusion criteria were based on the literature study (see chapter 2).

The scope of the land suitability analysis was set at the province Noord-Brabant in The Netherlands. Therefore, the first step was to remove all plots that fell outside the borders of this province. Secondly, all plots were removed that had a current land use considered unsuitable for development by CPC. An overview of what land uses were present and which were removed can be seen in appendix C. Land uses that were removed included e.g. traffic and nature areas. Some special land uses that were not removed from the vector layer were gardens (people with large gardens could potentially sell them in the future), sports (these could be bought and transformed into housing in the future) and several sub-uses of greenery. Types of greenery that had been removed include, but are not limited to, ‘water’, ‘nature’ and ‘landscape elements’. Land uses with simply the term “green” were not removed as not all of them might be unsuitable for CPC development (e.g. grass fields). To make sure that all plots located into parks were not taken into consideration (which could still fall under the landuse “green”), a vector file had to be created in the GIS-software with the OSM QuickSearch tool using the term “leisure = park”. The found areas were removed from the land use layer by using the “Difference” function.

One general exclusion criterion that was not found in the literature but that was assumed important, is that plots at locations where there is now infrastructure cannot be used for residential development, due to their importance for connecting people. In the literature study, it was found that no dwellings should be built in the vicinity of certain traffic locations. However, this exclusion criterion could not be achieved for all traffic location types, as busy urban roads could not be identified in the data file. Traffic locations that were identified have been removed from the original data layer. Even though it was not specifically mentioned in the literature, also areas near airports were excluded from consideration for residential development due to noise concerns. It is assumed that the necessary distance to keep from airports depend on the scale of the airport and number of flights, but in this study the same distance was used as for the minimum distance to keep from highways (200 meters). Once the vector layers for the airport, highway and provincial roads were imported, all locations within proximity of these infrastructure elements were selected (with the ‘Buffer’ function) and removed (with the ‘Difference’ function).

Table 4: Overview exclusion criteria

Exclusion criteria
Plot cannot be located where there are unsuitable land uses
Plot cannot be located in a park
Plot cannot be located where there is now infrastructure.
Plot cannot be located where there are now airports or in proximity (200 meter) of airports
Plot cannot be located in proximity (150 meter) of highways
Plot cannot be located in proximity (50 meter) of provincial roads.
Plot cannot be located where there are now village- or city (market) squares.
Plot cannot be located underneath- or in proximity (200 meter) from above-ground power lines.
Plot cannot be located in proximity (200 meter) of wind turbines.

The final general exclusion criteria applied were that plots could not be located at city or village squares, in the direct surroundings of wind turbines and in the direct surroundings of above-ground power cables (see chapter 2). However, no precise distance was found for what is considered "living near power cables" or "near wind turbines". Therefore, in this study a distance of 200 meters is assumed. Acquiring a data layer for town or city squares was done using the OSM QuickSearch function. Vector data layers for power lines and cables were acquired from Hoogspanningsnet.com (2022) and for wind turbines from National Georegister (2023). In the file for power lines, the location of the cables (underground or above ground) was not always accurate. For consistency sake, only power cables (above ground) were included in the general exclusion criteria. Plots within close proximity to power cables and wind turbines were removed in a similar manner as used for the infrastructure elements. An overview of all general exclusion criteria can be seen in table 4.

Plots could have been sliced into more than one fragment due to the previous use of "Difference" functions. However, still, these fragments counted as one plot in the software, even though they were not connected. An example can be seen in figure 3, where the selected plot (in yellow) consisted of two fragments. Solving this problem so each individual fragment was an individual plot, could be done with the Multipart Split plugin in QGIS, of which the results can be seen in figure 4.

Figure 3: Example not-connected plot

Figure 4: Example removal not-connected plot

It might be necessary in some projects to exclude all plots that already have buildings on them. However, in some projects, this is not wanted as regeneration of an existing building is also an option. Therefore, the choice has been made not to exclude these plots from total consideration. Instead, for every plot, a new attribute was added that tells what percentage of the plot is built upon. This has been done by accessing a building vector layer through (Geofabrik, 2018). The steps conducted to acquire the percentage of built upon area can be seen in appendix D.

3.3.2. Evaluation assessment

In this subsection, the methods are provided to answer the question: what are the suitability levels of plots used for CPC development? This will be done based on a location based suitability assessment. In such an assessment, different criteria (layers) are given scores. These layers are then combined using a weighted linear combination approach. In this subsection, the included attributes and their data origin are explained, followed by the method to create a suitability map.

3.3.2.1. Included attributes

A suitability evaluation requires several attribute values to be gathered. In order to find (the most) suitable areas for CPC development, the used attributes need to be based on evidence. Therefore, in this suitability evaluation, attributes are mostly based on the literature review, as price, level of urbanity, level of greenery, proximity to public transport stops and the cycling network are all found to influence residential decision making. The possibility of communal spaces is included as it tends to improve social interaction and increase solidarity (Monton et al., 2022). Proximity to the supermarket is also included since Van den Berg et al. (2021) found that living in closer proximity to a supermarket positively influences neighbour support. The data origin for every attribute is now explained.

Price of the plot

The data layer to determine the price of the plot is derived from the neighbourhood and districts map published by the CBS (2023i). This is a vector layer where the most recent version could be downloaded of the year 2022. From this dataset, locations of city centres were obtained and filtered by scanning through the attribute 'Name'. This is done since the price of a plot can partly be determined by the distance to the nearest city centre. These distances were categorized into five categories: a 0 to 5 kilometre distance from the nearest city centre, a 5 to 10 kilometre distance, a 10 to 15 kilometre distance, a 15 to 20 kilometre distance or a distance larger than 20 kilometres. For every category, a small analysis was done regarding the price per sqm of land in several towns, cities or municipalities in Noord-Brabant. The total overview of this analysis can be seen in appendix E. In this analysis, 27 towns and cities had their current average price (in Euro's) per sqm published, of which 23 locations could be used for comparison. For every town or city, the level of urbanity, land prices and source of the data were extracted. These settlements were then grouped based on the distance to the nearest city centre, for which the average price per sqm was used in the suitability analysis. Based on the results, locations within 5 kilometres from a city centre have an average land price of 447 Euro's per sqm, locations within 5-10 kilometres have an average price of 430 Euro's per sqm, locations within 10-15 kilometres have an average price of 400 Euro's per sqm, location within 15-20 kilometres have an average price of 327 Euro's per sqm and locations located more than 20 kilometre from a city centre have an average price of 290 Euro's per sqm. These average costs per sqm were multiplied with the area of the plots to determine the total price per plot.

An important note is that these average prices per sqm in practice differ per municipality, meaning that not every distance (to city centre) group actually has the same prices. Furthermore, it must be noted that only a limited number of locations could be included in the average price per sqm analysis, since either a) the number of (very) highly urbanized areas is limited, b) not all municipalities use an average price per sqm for land price determinant or c) not all municipalities have published their land price data. Still, the outcome of the analysis is used to determine the approximate cost of the plot.

Level of urbanity

The data layer regarding the level of urbanity in which the plots are situated was acquired through datasets from the CBS (2023i). The most recent dataset suitable for this GIS analysis originates from 2022. This dataset is a vector layer which includes the level of urbanity on a scale of 1 (very strongly urban) to 5 (not urban). The level of urbanity was determined based on the number of addresses per square kilometre. The datasets could be downloaded for the whole country, on either municipal, district or neighbourhood level. The more detailed the level, the larger the dataset. In this study, the dataset on district (Dutch: wijken) level was used.

Distance to closest public transport stop

Assessing the distance to the closest public transport (PT) stop was done using a data layer for 'public transportation stops'. This data layer was acquired with the QuickOSM tool connected to the GIS software QGIS. Public transport stops consist of all bus stops, tram stops and train stations. To select these points, the keys and values as presented in figure 5 were used. Distances were calculated in the QGIS software by using the NNJoin plugin.

		Key	Value	Add	Delete
1		highway	bus_stop		
2	Or	amenity	bus_station		
3	Or	railway	tram_stop		
4	Or	railway	station		

Figure 5: QGIS keys and values for public transport stops

Distance to closest supermarket

The vector data layer for this attribute was obtained in a similar manner as for the PT stop data. The data layer was assessed for supermarkets, which was acquired by using the QuickOSM tool. Distances were calculated with the NNJoin plugin.

Green in the area

The data layer for the level of green in the area was accessed through data published by the Dutch Climate Effect Atlas (Klimaateffect Atlas, 2023). This vector data layer shows the density of green in the area on neighbourhood level. For each level of greenery in the area, a different vector layer was generated. In total three vector layers were generated (low-, medium- and high level of greenery). The different benchmarks for the level of greenery stem from Datalab Gelderland Oost (2023). Areas with a low level of greenery have < 30% of their land covered in greenery, medium level of greenery have 30-60% covered and high levels of greenery have 60-100% covered in greenery. The 30% benchmark is used since this is the target percentage in The Netherlands according to Datalab Gelderland Oost (2023). The 60% benchmark is used since this percentage is very close to the average percentage in neighbourhoods in The Netherlands (61%). The areas with a high level of greenery are thus all above average.

Connection with cycling network
The connection with the cycling network was assessed by measuring the distance to the main cycling network. Therefore, a vector layer was required of the cycling network. This data layer was acquired through QGIS with the QuickOSM tool. Selecting the cycling network was done by using the keys and values as presented in figure 6.

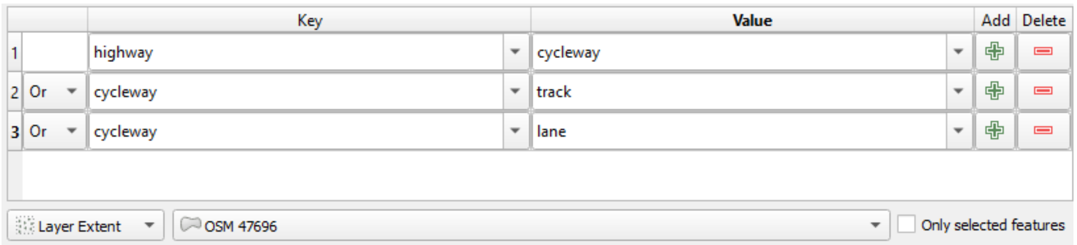

Figure 6: GIS keys and values for cycling network

Possibility of communal spaces
The possibility of having communal spaces within the CPC project depends mostly on the size of the plot. The plots that are analyzed were based on the dataset including the municipal land uses (Dutch: enkelbestemmingen) downloaded from PDOK (n.d.). A new attribute "Area" was then added to this dataset.

The minimum required area of the plot depends on four preferences of respondents. First, it depends on the number of dwellings to be built in the project. Second, it depends on the wishes from the group regarding the size of their dwellings. On average, in The Netherlands one person lives in a dwelling of 53 sqm (CBS, 2022d). However, the area per person differs based on region in the country and household composition. For example, one person households have an average of 88 sqm in total, while households with children only have an average of 37 meters per person (CBS, 2022d). Furthermore, per dwelling, a parking norm of 1.5 parking spaces per dwelling is used. Each parking lot requires an additional 25 sqm. So for each dwelling, parking needed an additional 37.5 sqm of space. Fourth, the number of floors in which the dwellings will be build influences the minimum required area. For example, six dwellings of 90 sqm which are built on the ground require a plot of minimum 540 sqm, while if these six dwellings are spread over two floors, only 270 sqm is necessary. Fifth, the desired communal facilities impact the minimum area necessary. No data could be obtained for the required area of communal indoor and outdoor spaces, especially since these can vary in size and presence. The formula to determine the minimum plot area is:

$$Minimum\ plot\ area = \#dwellings * \left(\frac{area\ per\ dwelling}{\#floors} + parking\ area\right) + \frac{area\ indoor\ communal\ space}{\#floors} + area\ outdoor\ communal\ space) \quad (9)$$

3.3.3. Creating a suitability map

In this subsection, the steps to assess the suitability scores are explained in further detail. An overview of these steps can be seen in figure 7. First, all data layers were manipulated. By doing this, all individual data layers are prepared for utilization in the suitability assessment. Then, all individual data layers were combined into one vector layer containing all relevant information. This layer should be used to perform the suitability assessment. In the assessment, first the individual criteria scores will be calculated after which the total suitability score will be calculated. Since this suitability score is merely an added attribute, a map will be created in which all suitable plots and their scores are visually represented.

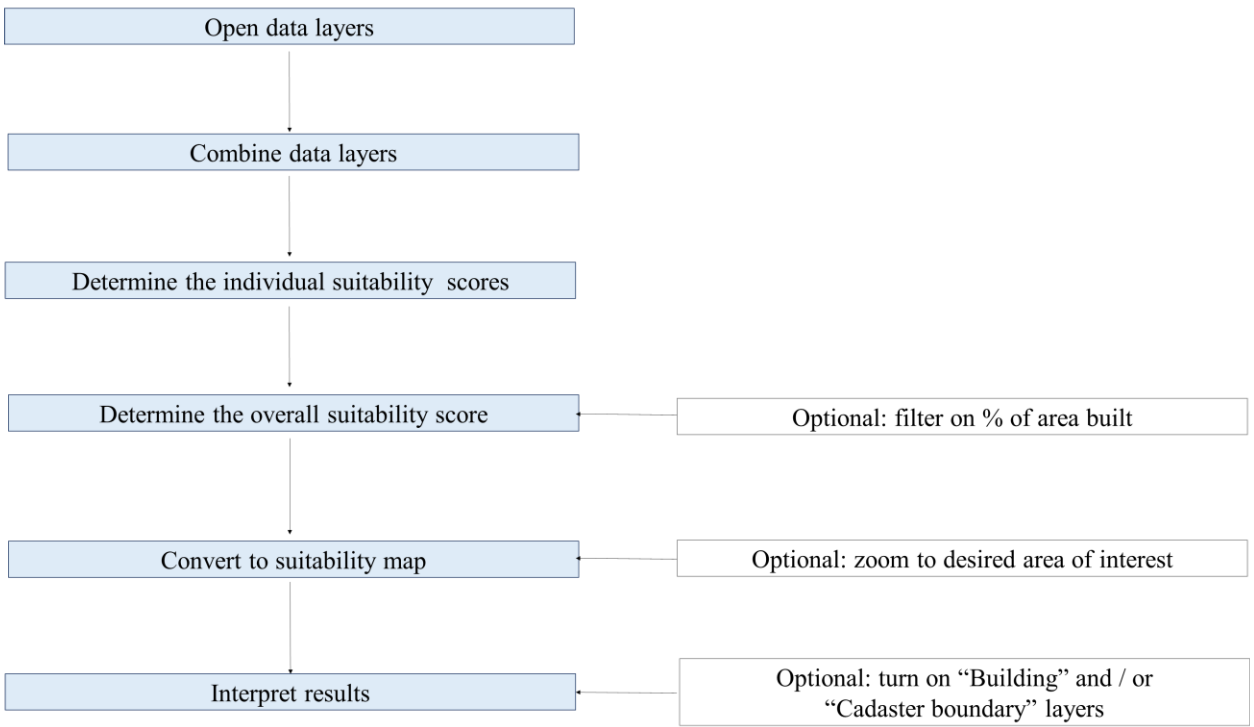

Figure 7: Overview steps to create and interpret suitability map

For an overview of all individual data layers, see appendix F. After all relevant attribute information was gathered from the described data sources, the next step in the suitability analysis was to add this information from the independent attribute layers into the base layer. In the end, the vector data layer with all the plots should have information concerning a) price level of properties in the neighbourhood, b) level of greenery in the neighbourhood, c) in what level of urbanity the plot is situated and d) the closest distance to a supermarket, e) public transport stop and f) main cycling network. Attribute data of the price level, level of greenery and urbanity of the neighbourhood were added by using the function "Join Attributes by Location". The distance to the nearest city centre, supermarket, public transport stop and cycling network were added by using the NNJoin plugin.

Determine the individual suitability scores

The overall suitability score is the result of an additive formula that combines the individual attribute scores. As there are seven independent attributes in this study, the formula to determine the overall suitability score consists of seven independent formula components. The suitability score of every formula component will be added to the dataset separately. This way, it is easier to assess the individual attribute scores of a plot. These formula components will be further explained in chapter 6.

Determine the overall suitability score

The formula to determine the overall suitability score is the result of the summation of all formula components. If any individual, attribute related, suitability score was equal to -9999 (an incorrect value), then the plot is not suitable for development and should be excluded from the suitability analysis. These plots are however not removed from the dataset since in the tool, since users might want to include these excluded plots. The used expression to determine the overall suitability score is:

```
CASE
WHEN  "UtilityPT" = -9999 OR  "UtilityPri" = -9999 OR  "UtilitySup" = -9999 OR  "UtilityCyc" = -
9999 OR  "UtilityAre" = -9999 OR  "UtilityUrb" = -9999 THEN NULL
ELSE  "UtilitySup" + "UtilityPri" + "UtilityPT" + "UtilityGro" + "UtilityCyc" + "UtilityAre" +
"UtilityUrb"
END
```

Convert to suitability map

The output of calculated overall suitability score can be added to the dataset in a separate column in the attribute table. However, for transparency, the suitability score should also be visually interpretable. Therefore, a suitability map will be created that shows only plots considered suitable for CPC development. The map of suitability scores generated for the used example can be seen in chapter 6 after applying the calculated attribute weights to the suitability formulas.

4. Stated choice experiment

The data was collected using a stated choice experiment. In this chapter, the stated choice experiment is explained. In the stated choice experiment, respondents were asked to choose their preferred alternative in a choice-set based on pre-set attributes and their attribute levels. Therefore, in this chapter, all choice-sets, alternatives, attributes and attribute levels are explained. This chapter starts with the specific experimental design in this study, followed by how the survey was set-up and presented to the respondents and concludes with the method of data collection.

4.1. Experiment design

As the problem has been defined (stage 1, Hensher et al. (2015)), the stimuli or attribute (levels) need to be determined (stage 2). Respondents were given multiple choice sets of two alternative locations to consider for their CPC development of which they had to choose the most optimal location. In a choice set, the options can be explained by constant and varying attributes, their attribute levels and what attribute levels are assigned to a given alternative. According to Hensher et al. (2015), generating the alternatives and the choice sets is a crucial step in stated choice models as they may impact the reliability of the ultimate model outputs. The fixed attributes are identical for every alternative. In total, there are six fixed attributes used in this studies' SCE. Some of these attributes were based on the literature study on CPC, while others are attributes of considered relevant for all residential developments (standard dwelling, newly built dwellings, parking). An overview of these can be seen in table 5.

Table 5: Overview fixed attributes SCE

Characteristic	Explanation
Standard dwelling	The dwellings to be built will be 2- or 3 room dwellings.
Size of project	In the project 15-20 dwellings will be built.
Type of project	The dwellings will be built using the CPC development method.
Sustainability	The dwellings will include solar panels and a heat pump.
Newly built dwellings	All dwellings will be built entirely new (thus no renovation projects)
Parking	There will be at least one parking space available per household.

Then, the attributes needed to be determined that will vary during the stated choice tasks. In total, seven varying attributes were included. These attributes all consist of three different attribute levels. Each alternative in the stated choice tasks could only have one of these levels per attribute. These attributes are mainly based on the literature and include the price of the plot, the level of urbanity, the proximity to public transport and the supermarket, greenness, access of cycling facilities and possibility of realizing communal spaces. However, not all attributes identified in the literature could be included in the choice alternatives, since this would result in a too large experiment. The excluded attributes were either included as context attributes (e.g. parking facilities) or could have been implied under the notion of level of urbanity (e.g. walking or employment facilities). Regarding the latter, people could understand that living in a city centre has more employment facilities in walking distance, than if one is living in the countryside. An overview of all the varying attributes and their levels can be seen in table 6Table 6. An overview of the longlist of all optional attributes can be seen in appendix G.

Table 6: Overview attribute and attribute levels

Attribute	Level 1	Level 2	Level 3
Price of the plot	360,000 Euro	400,000 Euro	440,000 Euro
Level of urbanity	City centre	Edge of the city	Village or countryside
Distance to closest public transport stop	5 minute walk (< 400 meter)	10 minute walk (< 800 meter)	15 minute walk (< 1200 meter)
Distance to closest supermarket	5 minute walk (< 400 meter)	5 minutes cycling (< 1500 meter)	> 5 minutes cycling (> 1500 meter)
Greenery in the area	Low level of greenery	Medium level of greenery	High level of greenery
Cycling in the area	Excellent connection with main network	Good connection with main network	Poor connection with main network
Possibility of communal spaces	Only possibility of communal indoor spaces	Only possibility of communal outdoor spaces	Possibility of both communal indoor- as outdoor spaces

The next step was to allocate the attributes to the design columns and generate the choice sets. In total there were seven varying attributes in the choice tasks which each had three possible attribute levels. Using an orthogonal design, 27 alternatives were created. The alternatives were then copied, after which each alternative was paired with another alternative. For pairing the alternatives, randomness was used. After random pairing, each pair was checked for soundness. This meant that I) a pair could not exist of two identical profiles (e.g. profile #5 with profile #5) and that II) a pair should not have a clear favourite. A favourite was present when an alternative had a more attractive attribute level (e.g. price of the plot is 360,000 Euro instead of 440,000 Euro) for the majority, if not all, of the attributes. In the end, 27 pairs of alternatives were created since this would allow all profiles to be present an equal amount of times in the survey set-up. Furthermore, having 27 pairs would make it possible for the respondent to only choose from nine pairs of alternatives. This was done by dividing the 27 pairs into three groups, where every individual was assigned randomly to one group. Since the respondent only needs to choose their preferred alternative from nine pairs of alternatives, the duration of filling in the survey was reduced. This made it more appealing for respondents to participate in the survey. All 27 pairs of alternatives can be found in appendix H.

The next step was to create the choice tasks. Each choice task consisted of a description of the constant attributes, table presenting two alternatives and their attribute levels, and the answer option. In the stated choice tasks, the alternatives had a generic label (e.g. residential location A). The contents (in Dutch) and lay-out of a choice task can be seen in figure 8.

*Stelt u zich voor dat u bezig bent een locatie te vinden waar uw nieuwe woning gebouwd gaat worden met een CPO project. Op iedere locatiekeuze die u te zien krijgt, kunt u ervan uit gaan dat er 10 tot 25 standaard woningen worden gebouwd op de locatie. Deze woningen zullen nieuwbouw woningen zijn met minimaal één parkeerplaats per woning. Daarnaast worden alle woningen voorzien van duurzame systemen, zoals zonnepanelen en een warmtepomp.

Welke woonlocatie zou u kiezen? Mocht geen van beide locaties u aanspreken, kies dan voor 'Geen van beide'.

Kenmerken	Woonlocatie A	Woonlocatie B
Prijs voor de grond	400 000 Euro	360 000 Euro
Mate van stedelijkheid	Binnenstad	Dorp of platteland
Afstand naar dichtstbijzijnde openbaar vervoer halte	Tot 5 minuten lopen	Meer dan 5 minuten fietsen
Afstand naar dichtstbijzijnde supermarkt	Tot 5 minuten lopen	Tot 5 minuten fietsen
Groen in de omgeving	Enigzins groene omgeving	Erg groene omgeving
Fietsen in de omgeving	Erg goede verbinding met fietsnetwerk	Goede verbinding met fietsnetwerk
Mogelijkheid van gezamenlijke ruimtes	Alleen mogelijkheid tot gezamenlijke binnenruimtes	Mogelijkheid tot zowel gezamenlijke binnen- en buitenruimtes

Ik kies voor:

Woonlocatie A | Woonlocatie B | Geen van beide

Figure 8: Example choice task

4.2. Survey set-up

The survey used for this research was conducted online. The survey had been carried with the acceptance of the ethical review board of the Eindhoven University of Technology. An online (quantitative) method had been used to reduce the efforts and time necessary for both the researcher and the respondents. The used software for making and distributing the online survey was LimeSurvey. This tool allowed to gather the data and export them directly to further analysis software. Furthermore, this tool allowed the researcher to set certain conditions considering the answers and follow-up questions. This was useful since both individuals interested in CPC projects as those not interested were asked to fill in the survey. This shortened the duration of filling in the survey by individuals not interested in CPC projects, for example:

After filling in the stated choice tasks, respondents were asked for their experience and knowledge with collective private commissioning projects. If the participant indicated that they had no interest or experience with CPC projects, no further questions were asked. However, if they had indicated that they had experience with CPC project development, further questions were asked related to the size of their CPC project, what attributes they considered important for the location and what the duration was of finding a location.

This section further explains the set-up of the survey conducted according to the framework of stated choice experiments. An overview of the set-up of the survey can be seen in figure 9. First, the type of respondents approached and the desired number of them are given further detail. The survey is explained in the same order as presented to the respondents. In total, seven types of questions can be identified. First, the introduction and ethical part of the survey are explained, followed by the selection- and introductory questions, the explanation of the choice tasks, what attributes were included and what attribute levels they possessed, filling in the stated choice tasks, personal questions regarding the respondents' experience and knowledge of CPC developments and finally, questions regarding the personal characteristics of the respondents.

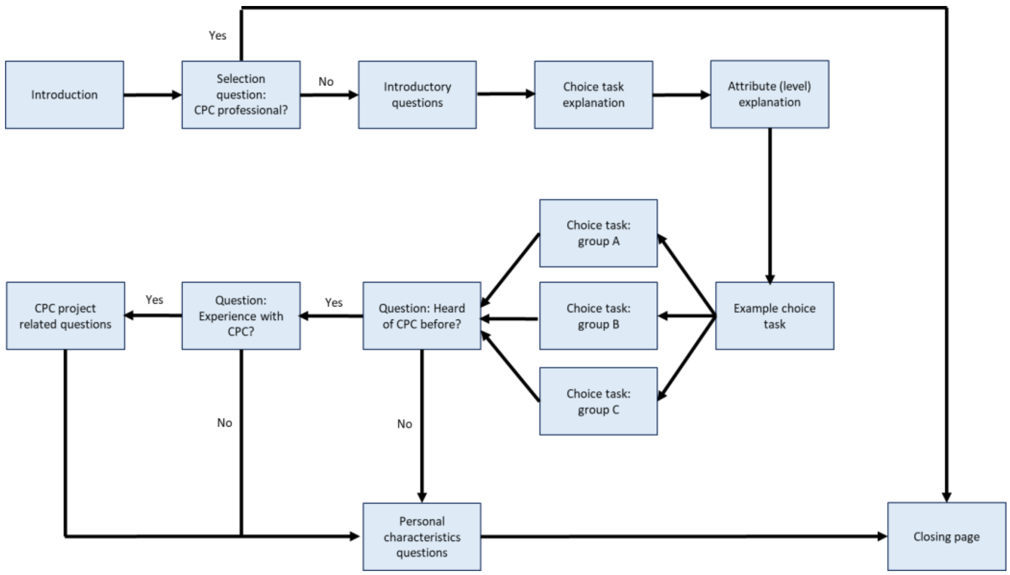

Figure 9: Overview of the survey structure

4.2.1. Respondents

The aim of discrete choice modelling in this research is to gather attribute weights to be included in the to be developed tool. More importantly, the data gathered aims to shed insights in the preferences of living locations and how they vary across socio-demographic groups and related to collective private commissioning. Since the influence of CPC projects on living preferences are investigated, the group of respondents should consist of both a group without interest in CPC projects and a group with interest in CPC projects. The method of identifying and approaching these respondents can be found in section 5.3. In short, the methods used for approaching these respondents were through contacting CPC groups directly, via advisory companies, distributing flyers or by approaching the personal network through LinkedIn or other communication platforms. The respondents were expected to be mostly Dutch citizens. Therefore, the survey was only constructed and distributed in Dutch. The survey can be found in full extent in appendix I.

4.2.2. Introduction

The online survey started with an introduction by welcoming the respondent to the survey. In this welcome message, the study and its aim, the researcher and the structure of the survey was given. The ethical component of the survey was provided after the welcome message. This ethical component mainly asked the respondent whether they grant permission for using the data later in the analysis. If the respondent did not grant permission, the survey was terminated. If they did grant permission, they could proceed. An overview of this introduction page (in Dutch only) can be seen in figure 10.

Onderzoek naar woonwensen en motieven

Beste respondent,

Welkom bij deze vragenlijst voor mijn afstudeeronderzoek. Dit onderzoek voer ik uit voor mijn master aan de Technische Universiteit in Eindhoven. Mijn onderzoek gaat over de verschillende woonvoorkeuren en –motieven, waarbij vooral wordt gekeken naar de locatie van een woning.

Het invullen van de vragenlijst is vrijwillig. In deze vragenlijst wordt u gevraagd om een keuze te maken tussen twee mogelijke locaties om te gaan wonen. Het invullen van de vragenlijst duurt ongeveer 10 minuten. Uw antwoorden worden anoniem opgeslagen en verwerkt. Bij deze wil ik u alvast van harte bedanken voor het invullen van de vragenlijst. Mocht u nog vragen hebben dan kunt u contact opnemen met mij via: j.w.m.poel@student.tue.nl.

Met vriendelijke groet,

Jasper Poel
Master student TU/Eindhoven

Figure 10: Introduction page of the online survey (in Dutch)

4.2.3. Selection and introductory questions

The selection question was shown after granting permission to use the data of the respondent. This selection question asked whether the respondent is professionally active in collective private commissioning developments. If the respondent was professionally active in this field, the survey was terminated. If the respondent was not, they could go further to the introductory questions. The reason for terminating the survey was that this study focusses on the preferences of individuals on the (CPC) housing market and being professionally active in it might influence the decisions made during the stated choice tasks.

The introductory questions were included to make sure the participant understands the context of the study, residential decision making, before answering the stated choice tasks. Furthermore, it also made them already familiar with the topic and answering questions within the LimeSurvey software. In total there were three introductory questions. First, the participant was asked to state whether they currently live independently or with others (e.g. student housing, with housemates). Second, they were asked whether they currently live in an owner-occupied or rental home. For both these questions, there was also the option the evade answering the question, by having an answer option ‘I would rather not say’. The third and final introductory question asked the importance of various residential characteristics. For eight characteristics, the respondent had to fill in how important they consider them in situations where they would move to a new home. The answer possibilities ranged from ‘very unimportant’ (1) to ‘very important’ (5). The eight characteristics were based on the advantages of collective private commissioning as identified in the literature review. By asking this question, the influence of CPC projects on the importance of location in residential decision making could later be analysed. The included characteristics were the location of the dwelling, the affordability of the dwelling, sustainable living, independent living, neighbourliness, preventing loneliness, ease of having social relations and having more design freedom of the dwelling. An overview of selection- and introductory questions and their answer options can be seen in table 7.

Table 7: Overview selection and introductory questions

Selection question	Answer options				
Are you at the moment professionally involved with building dwellings through CPC?	Yes			No	
Introductory questions	**Answer options**				
Are you currently living independently or with others?	Independently		With others		Rather not say
Are you currently living in an owner-occupied or rental dwelling?	Owner-occupied		Rental		Rather not say
Imagine that you are moving to a new home, how important would you rate the following attributes of your new home: A. Location B. Better affordability C. Sustainable living D. Independent living E. Neighbourliness F. Preventing loneliness G. Ease of social relations H. More design freedom	Very unimportant	Unimportant	Neutral	Important	Very important

4.2.4. Choice task explanation

The next step was to explain the main part of the survey to the respondents: the choice tasks. First, the survey asked the participants to picture themselves in a scenario where they are looking for a location to develop according to the CPC development method. They were asked to watch a short video to help them understand the concept of CPC (see: Veelers, 2012). After this, they were explained that during the stated choice tasks, they are asked to choose the most ideal location out of two alternatives. The alternatives varied based on seven attributes, while there were also some context related characteristics which are identical for each alternative.

4.2.5. Attributes and attribute levels

The next part of the survey explains all the attributes and attribute levels which were used in the stated choice tasks as explained in section 4.1. First, the characteristics were explained which are identical for each alternative, followed by the varying attributes. An overview of all the varying attributes and their attribute levels can be seen in Table 6. For the greenery attribute, visuals were created for better interpretation. These can be seen in appendix I.

4.2.6. *Choice tasks*

The next task was to conduct the stated choice tasks. Before, the respondent was asked to complete them, they were provided with an exemplary choice task to get familiar with the type of question and how to answer. Each choice task consisted of a description of the constant characteristics, table presenting both alternatives and their attribute levels, and the answer option, which was a bootstrap function. The contents (in Dutch) and lay-out of a choice task can be seen in figure 3. Figure 8Participants were also able to click on the greenery attribute levels of both alternatives, which then provided them with a visual reminder of what was meant with 'low level', 'medium level' or 'high level' of greenery.

As has been explained in section 4.1, 27 pairs of alternatives were created. It was however too much work for the respondents to evaluate 27 pairs of alternatives. Therefore, three groups were made of nine pairs each. By random allocation in the LimeSurvey software, respondents were asked to complete one group of pairs, meaning that they were asked to indicate their preferred alternative of living location nine times. A division of the grouping of the 27 pairs of alternatives can be seen in appendix H.

Table 8: Experience and follow-up questions

Q: What is your experience with CPC?	
Answer option	**Follow-up questions, CPC related?**
I have heard of CPC, but have no interest in participating in a CPC project.	No
I have interest in participating in a CPC project	No
I am currently busy with the initiation phase of a CPC project.	Yes
I am currently busy with the construction phase of a CPC project.	Yes
I am currently living in a dwelling developed with a CPC project.	Yes

4.2.7. *Experience- and knowledge questions CPC*

Now, the stated choice tasks were completed. However, in order to be able to analyse whether preferences are influenced by experience with or knowledge of collective private commissioning (CPC), this had to be asked. As has been mentioned before, in this part of the survey, question conditions had been used to reduce unnecessary effort for participants. First, the respondents were asked if they had heard of CPC before filling in this survey. If they indicated that they had not, they could continue with the other personal characteristic questions. If they indicated that they had heard of it, a follow-up question emerged. This question asked what their level of experience was in relation to CPC projects. Based on their answer, they could either continue with CPC related questions, or go forward to the personal characteristic questions. An overview on whether follow-up questions occurred based on their answer, can be found in table 8.

If the respondent indicated that they had experience with CPC , follow-up questions were asked. First, the person was asked the size (read: number of dwellings) of the CPC project, the four digits of the postal code of the CPC project location, the duration of finding a suitable location for the CPC project. Respondents were also asked to indicate for a number of CPC attributes, whether it had no, little or much influence on the residential location choice. This question was asked for a) the presence of communal spaces (indoor, outdoor), b) personal spaces (parking, private garden), c) sustainability implementations (solar panels, charging point electrical cars) and d) whether the project consisted of newly built dwellings or a renovation project. Furthermore, if there were any other CPC attributes influencing the location decision, they could indicate this as well. The digits of the postal code were asked to identify the level of urbanity of the location, which were used during the analysis. Finally, for each of the questions, respondents had an escape option where they could indicate that they had no idea or rather not share that information. For example, if they wished not to share the four digits of the postal code, they could indicate this by answering '0000'. An overview of the CPC related questions can be found in table 9.

Table 9: Overview CPC related questions

CPC related questions	Answer options					
Had you heard of CPC before filling this survey?	Yes	No				
What is your experience with CPC?	No interest	Interested	Initiation phase	Construction phase	Living in CPC dwelling	
How many dwellings will be built in your CPC project?	2-9	10-14	15-19	20-24	25+	Rather not say
For the following attributes of your CPC project, indicate the level of influence they had on the locational decision making: A. Sufficient parking space B. Communal indoor facilities C. Private gardens D. Communal outdoor facilities E. Solar panel, heat pump etc. F. Charging outlet electric cars G. Newly built dwellings H. Transformation existing building	No influence	Little influence	Much influence			
What are the first four numbers of the postal code of your CPC location?	Open ended question: four numbers					
What was the duration of your search for a location for CPC development?	< 1 year	1-2 years	2+ years	Rather not say		

4.2.8. Personal characteristics.

The last questions considered the personal characteristics of the respondents. For each question, the respondent had the option where they would 'rather not say'. All of the answer possibilities were based on similar classification as used by the Central Bureau of Statistics (CBS). These questions were asked to be able to analyse whether personal characteristics had an influence on the choice of living location. Furthermore, these questions were asked to see whether the group of respondents was representable for the entire Dutch population. Respondents were asked for their age, nationality, gender, education level, size of their household, postal code (again to identify the level of urbanity) and income, or rather their monthly disposable income per household. An overview of the distribution data of these characteristics can be seen in appendix J. An overview of the questions and answer options can be found in table 10.

Table 10: Overview personal questions

Questions personal characteristics	Answer options										
What is your age?	<24	25-34	35-44	45-54	55-64	65-74	75+	Rather not say			
What is your nationality?	Dutch	European	Non-European	Rather not say							
What is your gender?	Man	Woman	Other	Rather not say							
What is your highest completed education level?	Primary school	VMBO	HAVO VWO	MBO1	MBO2	MBO3	MBO4	HBO	University	Rather not say	Other
What is the size of your household?	One person	Two people	Three people	3+ people	Rather not say						
What are the first four numbers of your postal code?	Open ended question: four numbers										
What is your household income per month, after taxes (in Euro)?	<1500	1500-2000	2000-2500	2500-3000	3000-3500	3500-4200	4200+	Rather not say			

Once all questions were filled in, the exit page of the survey opened. In the exit page, the respondent was thanked for completing the survey and was invited to share the survey with others.

4.3. Data collection

The survey was distributed to people with prior experience or knowledge with CPC projects and to people without prior experience or knowledge. The method of contacting these people differs. First, people with experience or knowledge were contacted via the network of supervisor and assistant professor at the Eindhoven University of Technology, Stephan Maussen. Through his network, CPC advisory companies were contacted which agreed to forwarding the online survey to their client base. In total, nine advisory companies were contacted, of which six companies cooperated in distributing the survey. These companies are Kilimanjaro Wonen, De Steenvlinder, Bouwen in Eigen Beheer, Wij Ontwikkelen Samen, Bijker Advies and De Regie. Furthermore, Maussen forwarded the link of the survey towards a national (Dutch) institution operating in the field of collective private commissioning. Finally, also CPC groups with public contact details were approached directly by the researcher. Invitations for participation were send through a Facebook message, Instagram message or via e-mail. In total, 50 CPC groups were contacted directly.

People without prior experience or knowledge with CPC were contacted via the personal network of the researcher. This personal network was either contacted in person or via social media (WhatsApp, LinkedIn). Furthermore, due to the wish of having a larger database, flyers had been distributed in the direct neighbourhood of the researcher by placing folders at supermarkets and real estate agents. On these flyers, people were informed of the goal and topic of the survey, and they were able to access the survey through a web link or QR code. The lay-out of the flyer (in Dutch) can be seen in figure 11.

Figure 11: Invitation flyer for participating in online survey

5. Analysis

In this chapter, the results following the descriptive and discrete choice analysis are presented. The purpose of this analysis is to determine the attribute weights to use in the tool. This chapter starts with checking the representativeness of the sample for the Dutch population. Then the descriptive analysis results show the distribution of personal characteristics across the sample. The discrete choice analysis is based on a multinomial logit (MNL) model and latent class (LC) model. In the end, the most important findings are summarized. The underlying methodology for the discrete choice analysis can be found in chapter 3.

In this analysis, the answers of 163 respondents were used. The analysis was conducted with the NLOGIT software (Economics Software Inc., 2012). To prepare this data, effect coding was used. For more information on effect coding, see section 3.1.

5.1. Representativeness

In this section, the data was checked for representativeness. By comparing the personal characteristics of the respondents to statistics provided by the Central Bureau of Statistics (CBS), it was checked whether the sample group is representable for the Dutch population. Ideally, the representativity of the sample was checked with the Dutch CPC community. However, no database exists containing this information. All used statistics of the CBS were derived from its official website or database, for the most recent year available (CBS, 2022b-c; CBS, 2023a-c, i, j). For all personal characteristics, the most recent data was obtained from the year 2022. Only for the data regarding household income levels the most recent data was obtained from 2021. The results of the Chi-square test can be found in table 11 and indicate that the sample group is only representable for the Dutch population regarding the gender distribution and household size. For all other characteristics, the sample is not representable for the Dutch population.

Table 11: Chi-square results representativeness

Data origin	Characteristic	P-value
CBS or SCE	Age	0.005
	Nationality	0.000
	Gender	0.952
	Education level	0.000
	Household income level	0.000
	Household size	0.165
	Urbanity level	0.039
	Province	0.000
	Region	0.000
	Living situation	0.000
	Tenure situation	0.000

The full overview of the representativity numbers can be seen in appendix J. In this overview, to check the representativity, some statistics were either removed from the analysis or grouped. The age of respondents is rather distributed amongst the sample group. However, differences can be observed when comparing them with the data from the CBS. In total, two large differences were seen. First, the group of respondents ages 24 and under is 10% lower than in the Dutch society, mostly due to the group of respondents with CPC experience (which are generally speaking older). Second, the group of respondents between the ages 65 and 74 is double that of the Dutch population, again, mostly due to the group of respondents with CPC experience.

Nationality is also not representable for the Dutch population, as the share of native Dutch respondents is considerably higher, while the share of respondents with a nationality outside of Europe is completely absent. This is noteworthy, since 18% of the Dutch population has this nationality (due to immigration history with e.g. Morocco, Turkey, Indonesia or the Dutch Caribbean). Also the share of respondents with an European nationality is considerably smaller. A possible reason for the high share of native Dutch respondents can be that these groups might favour the topic and/or participation in CPC development more.

The distribution among gender (taking into account only male and female) is representative for the Dutch population. Amongst all respondents, the share of male to female is approximately 50-50, with a slight tendency towards more female respondents. This can also be seen back across the Dutch population.

The education levels of the sample group vary much from the CBS numbers for the whole Dutch population. The share of higher educated people is more than doubled, while the share of medium educated people is more than halved. The share of lower educated people is even more than quartered. Thus, regarding education level, the sample group is not representative. Possible reasons for these variation are that the personal network of the researcher is used (studying at university level) or perhaps that people interested in CPC developments tend to be higher educated.

Also for the (household) income level it was seen that the sample group has a higher income level than the generic Dutch population, as the share of high incomes is doubled. Since the share of medium income does hardly vary, this means that the number of lower incomes is halved. The division of shares amongst household income groups can also partly stem from the higher education levels, as people of higher education are more likely to earn more money (ILibrary, 2023).

The household size is also not representative for the Dutch population. The main differences lie within the division of one-person households and two-person households. The share of respondents in one-person households is more than halved, while the share of two person households has risen by almost 50%. One possible reason for this is that people with experience in CPC projects tend to live in two-person households.

The distribution of the respondents regarding living in a neighbourhood with a specific level of urbanity can be seen almost representable for the Dutch population. Still, it was seen that small variations occur. The share of people living in very highly- and slightly urban areas is lower, while the share of people living in non- and moderately urban neighbourhoods is higher. The variation in share of people living in highly urbanized areas can be neglected.

The distribution of the respondents across the countries' provinces is not representable for the Dutch population. The share of people living in Noord-Brabant and Utrecht is considerably higher, while the share of people living in the most populated provinces (Noord- and Zuid-Holland) is considerably lower. For some provinces (Groningen, Drenthe, Flevoland), there are even no respondents. It must be noted though, that these are the least populated provinces in the country. Possible reasons for these variations can be that the personal network of the researcher is used or that some (larger) CPC groups were more eager to fill in the survey (Ecowijk Mandora, Houten).

5.2. Descriptive analysis

In this section, the descriptive analysis shows the main findings of how the sample group is distributed amongst personal characteristics. The sample group is separated in a group with CPC experience and a group without CPC experience. These two groups are separately subjected to a descriptive analysis.

5.2.1. Introductory questions

The majority of the sample currently lives independently, as can be seen from table 12. It can furthermore be seen that a relatively smaller share of the respondents without CPC experience lives independently, in comparison with the respondents with CPC experience. Considering the tenure status, similar observations can be made. The majority of the whole sample currently resides in an owner-occupied dwelling, with a relatively smaller share of respondents without CPC experience living in said dwellings.

Table 12: Overview introduction questions

Characteristic	All respondents		Respondents with no CPC experience		Respondents with CPC experience	
Living status	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Living independently	124	76.1	45	67.2	79	82.3
Living collectively	39	23.9	22	32.8	17	17.7
Total	*163*	*100*	*67*	*100*	*96*	*100*
Tenure status	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Owner-occupied dwelling	131	80.4	44	65.7	87	90.6
Rental dwelling	32	19.6	23	34.3	9	9.4
Total	*163*	*100*	*67*	*100*	*96*	*100*

5.2.2. CPC related questions

People were also asked about their affinity with collective private commissioning. First, it can be seen in table 13 that the majority of the respondents had heard of CPC prior participating in the survey. The group of respondents with CPC experience consists of respondents that indicated that they were either currently involved in the initiation or construction phase, or indicated that they are living in a dwelling realized with a CPC project.

Table 13: Overview questions about prior knowledge and experience with CPC

Knowledge of CPC	Frequency	Percent
I had heard of CPC prior participation.	122	74.8
I had not heard of CPC prior participation.	41	25.2
Total	*163*	*100*
Experience with CPC	**Frequency**	**Percent**
I have heard of CPC but have no interest in it.	18	14.8
I have interest in participating in a CPC project.	8	6.6
I am currently involved in the initiation phase of a CPC project.	22	18.0
I am currently involved in the construction phase of a CPC project.	20	16.4
I live in a dwelling realized with a CPC project.	54	44.3
Total	*122*	*100*

Respondents that indicated that they had prior experience with CPC projects were asked follow-up questions considering the size of their CPC project, what location attributes they considered important, the location of their CPC project and their duration of location identification. First, in table 14 can be seen that the majority of the respondents live as part of a CPC development project with 25 dwellings or more. However, also smaller CPC projects of 2 till 9 dwellings are common amongst the sample, as well as projects of 10 till 14 dwellings.

Table 14: Overview question CPC project size

Number of dwellings realized in CPC project	Frequency	Percent
2-9 dwellings	25	26.0
10-14 dwellings	19	19.8
15-19 dwellings	6	6.3
20-24 dwellings	9	9.4
25 dwellings or more	36	37.5
Rather not say or do not know	1	1.0
Total	*97*	*100*

The next thing asked to respondents with experience of CPC development was to indicate for eight project related attributes if they had influenced the decision making for choosing their development (and future living) location. Results can be seen in table 15. It can be observed that the qualities of most influence on the locational decision making were the possibility of having sustainable applications, followed by the presence of a private and communal garden. After this, the presence of a communal indoor space and the possibility to construct completely new dwellings (greenfield development) were considered of most influence. Regarding the presence of sufficient parking facilities and charging outlets for electric vehicles, varying levels of influences were given. Most of the respondent however indicated that renovating an existing building into new homes had no influence on the location decision. Still, in some projects, it was of importance.

Table 15: Overview influence project related attributes on location decision making

Sufficient parking facilities	Frequency	Percent
No influence	34	35.4
Little influence	32	33.3
Much influence	30	31.3
Total	*96*	*100*
Communal indoor space	**Frequency**	**Percent**
No influence	31	32.3
Little influence	20	20.8
Much influence	45	46.9
Total	*96*	*100*
Private garden	**Frequency**	**Percent**
No influence	22	22.9
Little influence	16	16.7
Much influence	58	60.4
Total	*96*	*100*
Communal garden	**Frequency**	**Percent**
No influence	21	21.9
Little influence	18	18.8
Much influence	57	59.4
Total	*96*	*100*
Solar panels, heat pump or other interventions	**Frequency**	**Percent**
No influence	4	4.2
Little influence	6	6.3
Much influence	86	89.6
Total	*96*	*100*
Charging outlets for electric cars	**Frequency**	**Percent**
No influence	36	37.5
Little influence	37	38.5
Much influence	23	24.0
Total	*96*	*100*
Newly build dwellings	**Frequency**	**Percent**
No influence	23	24.0
Little influence	25	26.0
Much influence	48	50.0
Total	*96*	*100*

Transformation of existing building into dwellings	Frequency	Percent
No influence	73	76.0
Little influence	15	15.6
Much influence	8	8.3
Total	*96*	*100*

Furthermore, respondents had the possibility to indicate other attributes of their project that were considered important for the locational decision making by answering an open-ended question. One person indicated that the opportunity of a fast development was a serious contributor in their locational decision making. Twelve people indicated that a walking proximity to a city or town centre was important in their location decision. Six respondents indicated that living in a green environment was an important quality of the location. Two respondents highlighted the suburban or rural location as important, of which one highlighted its reasons: calm neighbourhood, away from a busy road with a bigger city on cycling distance. Ten respondents indicated that the location should have been in close proximity to facilities such as the supermarket, shops (3), public transport (8) or healthcare (3). One respondent indicated that they specifically searched for an existing building with character. Furthermore, four respondents used this option to indicate that they did not have to search for a location, with three respondents indicating that the municipality offered their location for CPC development. Others indicated that the location was decided when they joined the CPC development. Three respondents indicated that their development location should be present in the town they were living in at that moment. Three respondents indicated that the location of the project within the country was important, whether it for family or work accessibility. Two respondents indicated that the location needed to be present within easy access of their social network. Finally, one respondent indicated that a private garden is not a necessity, as long as a balcony is present.

The provincial and urbanity level distributions could be derived from asking the respondents the four digits of the postal code of their development location. The results can be seen in table 16. Here it can be seen that the majority of the CPC projects reside in highly urban neighborhoods, while also a lot of projects reside in slightly urban neighborhoods. The levels of urbanity are defined by address density data from the Dutch Central Bureau of Statistics (CBS, 2023g). Regarding the provincial distribution, it can be seen that a lot of people indicated that their CPC project is located specifically in the province Utrecht, while also the southern provinces (Noord-Brabant and Limburg) have a large share of respondents living in them.

Table 16: Overview provincial- and urban distribution

Province	Frequency	Percent
Utrecht	27	28.1
Western provinces (no Utrecht)	8	8.3
Southern provinces	35	36.5
Eastern provinces	14	14.6
Northern provinces	1	1.0
Rather not say or do not know	11	11.5
Total	*96*	*100*

Urbanity level	Frequency	Percent
Very highly urban	10	10.4
Highly urban	34	35.4
Moderately urban	11	11.5
Slightly urban	18	18.8
Non-urban	12	12.5
Rather not say or do not know	11	11.5
Total	*96*	*100*

The last CPC related question asked the respondent for the duration of finding the development location. Results of this question can be seen in table 17. It can be observed that the majority of the respondents spend more than two years finding their location to develop. However, a serious portion spend less than one year on this step as well.

Table 17: Overview location identification duration

Duration location identification	Frequency	Percent
Less than one year	22	22.9
One to two years	18	18.8
More than two years	29	30.2
Rather not say or do not know	27	28.1
Total	*96*	*100*

5.2.3. Dwelling related preference questions

Furthermore, for the two groups with and without experience with CPC, their preferences for several dwelling related characteristics will be compared. These characteristics are based on the literature regarding the motives for participation in CPC projects. For each characteristic, the respondent was asked to indicate how important they value this characteristic of the dwelling, in case where they had to search for a new home.

A Chi-square test was conducted to test whether there are differences between the groups (with- and without CPC experience) regarding dwelling preferences. The level of significance was calculated by using the Pearson test that is asymptotic (2-sided). If the level of significance is lower than 0.05, it means that there is a difference of preference between the two groups for that specific attribute. The results of the Chi-square test can be found in table 18. From this test it was concluded that people with CPC experience have significantly different preferences towards the importance of affordability, sustainable living, neighbourliness and design freedom.

Table 18: Overview Chi-square test dwelling related preference

Subgroup	Dwelling related preference	P-value
Experience with CPC (yes or no)	Location of dwelling	0.092
	Affordability	0.000
	Sustainable living	0.000
	Independent living	0.760
	Neighbourliness	0.000
	Preventing loneliness	0.093
	Ease of social relations	0.083
	Design freedom	0.006

The descriptive results of the answers can be seen in Table 19. In this table, (percentage) statistics are given for every location characteristic asked. From the Chi square test however, it could be concluded that only the affordability, possibility of sustainable living, neighbourliness and design freedom significantly differ (at 5% interval). Regarding affordability, it was observed that the respondents with CPC experience value a better affordability in lesser degree than respondents without CPC experience. Furthermore, having CPC experience increases the importance of sustainable living, neighbourliness and design freedom. The chi square test also explained that regarding the importance of location, preventing loneliness and ease of social relations differ significantly at the 10% interval level. If this is respected, it can be concluded that respondents with CPC experience tend to value location as (slightly) less important, while preventing loneliness and ease of social relations is considered more important.

Table 19: Overview dwelling attribute importance

Characteristic	Respondents with no CPC experience		Respondents with CPC experience	
Location of the dwelling	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Neutral or (un)important	1	1.5	7	7.3
(Very) Important	66	98.5	89	92.7
Total	*67*	*100*	*96*	*100*
Better affordability	**Frequency**	**Percent**	**Frequency**	**Percent**
Neutral or (un)important	11	16.4	43	44.8
(Very) Important	56	83.6	53	55.2
Total	*67*	*100*	*96*	*100*
Sustainable living	**Frequency**	**Percent**	**Frequency**	**Percent**
Neutral or (un)important	17	25.4	6	6.3
(Very) Important	50	74.6	90	93.8
Total	*67*	*100*	*96*	*100*
Neighbourliness	**Frequency**	**Percent**	**Frequency**	**Percent**
Neutral or (un)important	36	53.7	16	16.7
(Very) Important	31	46.3	80	83.3
Total	*67*	*100*	*96*	*100*

Preventing loneliness	Frequency	Percent	Frequency	Percent
Neutral or (un)important	34	50.7	36	37.5
(Very) Important	33	49.3	60	62.5
Total	*67*	*100*	*96*	*100*
Ease of having social relations	**Frequency**	**Percent**	**Frequency**	**Percent**
Neutral or (un)important	35	52.2	38	39.6
(Very) Important	32	47.8	58	60.4
Total	*67*	*100*	*96*	*100*
Design freedom of the dwelling	**Frequency**	**Percent**	**Frequency**	**Percent**
Neutral or (un)important	36	53.7	32	33.3
(Very) Important	31	46.3	64	66.7
Total	*67*	*100*	*96*	*100*

5.2.4. Personal characteristics

In the end of the survey, several questions were asked regarding the personal characteristics of the respondents. These have been recoded so they fit the categories as identified in appendix J. This modification occurred for the education level, income level, urbanity level and provinces. An overview of the detailed provincial distribution can be found in appendix K. The Pearson Chi-square test provided information whether the group with CPC experience has significantly varying personal characteristics in comparison with the group of respondents without CPC experience. From the results of the Chi-square test, as seen in table 19, was observed that significant differences can be seen for all characteristics except nationality, gender and the education level.

Table 20: Overview Chi-square test personal characteristics

Subgroup	Characteristic	P-value
Experience with CPC (yes or no)	Age	0.000
	Nationality	0.782
	Gender	0.398
	Education level	0.786
	Household income level	0.000
	Household size	0.024
	Urbanity level	0.000
	Region	0.000

The full overview of the descriptive results can be seen in appendix J. From the results could be observed that regarding age, the total sample group is rather distributed, with the largest groups being ‘young seniors’ (65-74 years), ‘mediors’ (55-64 years) and ‘very young adults’ (ages 24 and younger). The group of people without experience with CPC consists more of ‘very young’ and ‘young’ adults, while in the group of respondents with CPC experience a significantly larger portion falls within the age categories of 65 years and older.

Looking at the household income distribution amongst the sample, it must be taken into account that higher education levels often lead to higher incomes (ILibrary, 2023). This could be the reason for the high share of respondents with high incomes. This relatively high income distribution was also seen in the group of respondents with CPC experience, while the group lacking experience had an equal distribution of income amongst its respondents. Furthermore, the majority of the respondents live in a households of two people. However, for the group without CPC experience, this share is significantly lower, causing larger shares for all other household sizes. Relatively, more two people households were seen in the group of respondents with CPC experience, leading to overall lower percentages for all other household size groups.

Finally, by asking the respondent for the four digits of their postal code, the province and urbanity level was extracted using data from the CBS (CBS, 2023f). Urbanity levels are rather distributed, where the largest portions of the sample group live in a moderately or highly urban neighbourhood. In the group of respondents without CPC experience, it was seen that, relatively, the portion of people living in (very) urban neighbourhoods does not change, while the number of people living in moderately urban areas is considerably higher. This influx of people in this group results in less people living in slightly- or non-urban neighbourhoods. Regarding the urbanity of the neighbourhoods of the group respondents with CPC experience, it was seen that, relatively, the portion of people living in (very) urban neighbourhoods does not change (approximately 50%). The share of people living in slightly urban neighbourhoods decreases however, leading to more people living in rural areas.

5.3. Discrete choice analysis

For the whole sample, two different model approaches of discrete choice analysis were conducted. This section will start by presenting the results of the MNL model for the whole sample followed by the latent class model results. More detailed discrete choice model results can be found in appendix L.

5.3.1. Multi-nominal logit model

The results of the MNL model for the whole sample group can be seen in table 21. It was seen that the output of the MNL model outperforms the null model based on the log likelihood values. This was concluded since the LL of the MNL model is closer to 0 than the LL of the null model. From comparing the Rho-squared adjusted value of the estimated model with the Rho squared adjusted value from the null model was observed that the estimated model has an adequate fit, since the value (0.214) is between 0.2 and 0.4.

Table 21: MNL model results

Statistic		Value
Log likelihood function		-1454.410
Restricted log likelihood (null model)		-1641.330
Log likelihood (constants only)		-1606.850
Inf. Cr. AIC. (2936.8 AIC/N)		1.966
Rho-squared (final model versus constants only)		0.096
Rho-squared (final model versus null model)		0.222
Rho-squared adjusted (final model versus constants only)		0.086
Rho-squared adjusted (final model versus null model)		0.214
Attribute level	**Coefficient**	**P-value**
Constant	0.415	0.000
Price = 360 000 EU	0.182	0.003
Price = 400 000 EU	0.120	0.034
Price = 440 000 EU*	-0.302	-
Inner city	-0.203	0.001
Edge of city	0.166	0.002
Village or countryside*	0.037	-
5 minute walk to PT stop	0.098	0.094
10 minute walk to PT stop	0.186	0.001
15 minute walk to PT stop*	-0.284	-
5 minute walk to supermarket	0.051	0.376
5 minutes cycling to supermarket	-0.036	0.537
>5 minutes cycling to supermarket*	-0.015	-
Low level of green	-0.712	0.000
Medium level of green	0.060	0.291
High level of green*	0.652	-
Very good connection with cycling network	-0.245	0.000
Good connection with cycling network	0.050	0.404
Poor connection with cycling network*	0.195	-
Possibility of communal indoor spaces	-0.224	0.000
Possibility of communal outdoor spaces	0.068	0.303
Possibility of both communal indoor- and outdoor spaces*	0.156	-

**Based on effect coding*

From the coefficient value for the constant was observed that the respondent often chose one of the choice alternatives presented to them instead of choosing neither. Furthermore, several significant results were observed. First, a higher price for the ground is less attractive, as it generates a lower total utility. Here there is a negative linear relation, the higher the price, the lower the attractiveness of a location. Second, people prefer a location in the suburbs. Living in the inner city is not appreciated, as it has a negative contribution to the total utility. This seems somewhat surprising. One possible reason can be that people prefer living in the suburbs since this is generally cheaper, provides more space and greenery and is less crowded with less noise. Also the distance to a public transport stop has a significant influence on locational decision making. Here, again, the results are unexpected. People tend to prefer locations at a 10-minute walking distance from a public transport, as it has a part-worth utility value that is twice as high of living in a 5 minute walking radius. A possible reason for this is that people do not want to live too close to public transport, due to increased noise levels from buses or trains or the crowdedness that these services attract. For greenery it can be seen that the higher the level of greenery in the neighbourhood, the more utility is derived from it. People thus prefer a development location in areas with a lot of greenery, which agrees with the found literature. Noteworthy however, is that not all coefficient values are significant. For the connection with the cycling network, surprising results were found. People prefer a location further away from the main cycling network. A possible reason for this is that living further away from this network results in less nuisance from other (often parallel located) traffic, such as noise or air quality degeneration. Again, it must be noted that not all coefficient values are significant. Finally, regarding the presence of communal spaces, it was seen that people prefer to have both communal indoor and outdoor spaces. If they have to choose between the two, only having communal indoor spaces has a lower utility than only having communal outdoor spaces. Here as well, it must be noted that only one coefficient value is significant. The distance to the supermarket is not found to be a significant contributor to locational decision making. This is in contrast with the literature.

5.3.2. Latent class model

Now, the latent class model results are shown. This latent class model has been included since it is an improvement to the MNL model. The results of the latent class model can be seen in table 22. It was seen that the LL of this model has a value closer to 0 in comparison with the MNL model, indicating an improvement in the model fit. Also, the Rho-squared (adjusted) of the estimated LC model has increased in comparison with the MNL model to a value of 0.294. In this latent class model, four classes were identified since this number of classes yielded the best model fit in comparison with a two or three class model. An overview of the model fits can be seen in appendix M.

LC group 1: Suburban dwellers

It was seen that in this group, the value of the constant has a positive value indicating that in this group, respondents mostly choose one of the presented alternatives instead of neither. Furthermore, it was seen that this group has a significant preference for the price of the ground, urban location, level of green in the area, distance to the cycling network and the presence of communal spaces. This group differs from other groups in the latent class model by being the only group that favors a location in the suburbs. Furthermore, among the four LC groups, this group has the strongest preference for the attribute price, where respondents in this group favor the lowest price. Furthermore, they have a strong preference for the level of greenery in the neighborhood of the location as they favor locations in a neighborhood with a high level of greenery. Other noteworthy aspects are that they have no significant preference for the distance to a public transport stop or supermarket, while they have a preference for a distance as far away from the cycling network (possibly due to road nuisance) and strongly favor the possibility of having communal indoor spaces over the possibility of having communal outdoor spaces.

LC group 2: Rural dwellers with preference for living close to amenities

Also in this group is the value of the constant a positive value. Regarding the location preferences, this group differs from the first group as they do not have a significant preference for the price of the ground and cycling network, while respondents in this group do have a preference for the distances from the location to the closest public transport stop and supermarket. This group prefers to be located at a ten minute walking distance from the supermarket and favor locations within a five minute walking distance from a supermarket. Furthermore, this group strongly prefers a rural location, followed by the suburbs and then the inner city. The combination of preferring a rural location while still preferring to be in vicinity of certain amenities (supermarket, public transport stop) is what distinguishes this group. Also this group has a significant preference for locations in a neighborhood with a high level of greenery, while it has a slight preference for the possibility of having only communal outdoor spaces.

LC group 3: Rural dwellers with strong relation to the outdoors

In this group, the value of the constant is negative. This means that respondents in this group more often chose neither of the presented alternatives. Respondents in this group differ from other respondents as they strongly prefer rural locations, but have no preference for the distance to the supermarket or distance of the location to the cycling network. For all other location related attributes, this group does have a preference. As said, this group prefers rural locations. This group also prefers locations at a ten minute walking distance from public transportation stops, have the strongest preference for locations in a highly green neighborhood and a strong preference for the possibility of having only outdoor communal spaces. Based on the strong preferences for green rural living and outdoor spaces, this group could be characterized by being the group where respondents have the strongest relation with the outdoors.

LC group 4 : urban dwellers

Also in this group is the value of the constant negative, indicating that respondents more often chose neither of the presented alternatives. Respondents in this group differ from the other respondents based on their strong preference for urban locations. The only other preference this group has is that is they strongly prefer plots with the possibility of having both communal indoor and outdoor spaces. For all other attributes, no significant preferences are found.

Table 22: Latent class model results

Statistic	Value
Log likelihood function	-1157.751
Restricted log likelihood	-1641.327
Log likelihood (constants only)	-1606.853
Inf. Cr. AIC. (2443.5 AIC/N)	1.636
Chi squared [63](P=.000)	965.152
McFadden Pseudo R-squared	0.294
Rho-squared (final model versus constants only)	0.279
Rho-squared (final model versus null model)	0.294
Rho-squared adjusted (final model versus constants only)	0.263
Rho-squared adjusted (final model versus null model)	0.279

	LC group 1		LC group 2		LC group 3		LC group 4	
Attribute level	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	3.268	0.000	2.330	0.000	-1.148	0.000	-1.280	0.000
Price = 360 000 EU	0.522	0.001	0.034	0.879	0.017	0.932	0.358	0.051
Price = 400 000 EU	0.103	0.377	0.240	0.360	0.461	0.024	-0.149	0.371
Price = 440 000 EU*	-0.625	-	-0.274	-	-0.478	-	-0.209	-
Inner city	0.245	0.105	-1.818	0.000	-2.107	0.000	0.871	0.000
Edge of city	0.492	0.000	-0.433	0.092	0.468	0.005	0.180	0.335
Village or countryside*	-0.737	-	2.252	-	1.639	-	-1.051	-
5 minute walk to PT stop	0.134	0.254	0.197	0.427	0.064	0.767	0.180	0.324
10 minute walk to PT stop	0.124	0.259	0.388	0.048	0.521	0.007	0.086	0.625
15 minute walk to PT stop*	-0.258	-	-0.585	-	-0.585	-	-0.266	-
5 minute walk to supermarket	0.052	0.683	0.592	0.037	-0.385	0.073	0.173	0.327
5 minutes cycling to supermarket	-0.038	0.736	-0.409	0.038	0.072	0.728	0.291	0.075
>5 minutes cycling to supermarket*	-0.014	-	-0.183	-	0.313	-	-0.464	-
Low level of green	-0.997	0.000	-0.744	0.001	-2.499	0.000	-0.040	0.835
Medium level of green	0.186	0.214	0.105	0.669	0.078	0.700	-0.183	0.341
High level of green*	0.811	-	0.640	-	2.422	-	0.223	-
Very good connection with cycling network	-0.318	0.015	-0.166	0.408	-0.252	0.201	-0.157	0.379
Good connection with cycling network	0.076	0.576	-0.391	0.103	0.024	0.904	0.129	0.449
Poor connection with cycling network*	0.242	-	0.558	-	0.228	-	0.028	-
Possibility of communal indoor spaces	0.204	0.125	-0.728	0.022	-1.063	0.001	-0.610	0.002
Possibility of communal outdoor spaces	-0.384	0.011	0.391	0.196	0.707	0.032	-0.734	0.000
Possibility of both communal indoor- and outdoor spaces*	0.179	-	0.337	-	0.355	-	1.345	0.000

**Based on effect coding*

Socio-demographic and personal characteristics

Next, the personal characteristics of the latent class groups were examined. LC group 1 consists of 64 respondents, LC group 2 of 30 respondents, LC group 3 of 33 respondents and LC group 4 of 36 respondents. The statistical differences of personal characteristics between these groups have been investigated with a Pearson Chi square test of which the results can be found in table 23. To conduct the Chi square test, as much null values as possible have been removed from the dataset. From this table can be concluded that the four latent class groups significantly (at 10% interval) differ regarding age, nationality, prior CPC knowledge, CPC experience and tenure status. An overview of the significant characteristics can be found in table 24, while an overview of all characteristics can be found in appendix N. From table 24 can be concluded that LC group 1 (suburban dwellers) could be characterized by being the youngest group, since 46.9% of this group is ages 34 or younger. Furthermore, respondents in this group had the least prior knowledge of CPC projects. LC group 2 (rural dwellers with amenities preferences) could be characterized by the even distribution of age classes. LC groups 3 and 4 are the two groups that have the most prior knowledge and experience with CPC projects. Both groups have a low percentage of respondents ages 34 and younger (12.2% for LC group 3, 8.4% for LC group 4), while LC group 4 (urban dwellers) has the largest portion of respondents aged 55 and older (69.5%).

Table 23: Chi-square results LC groups

Latent class group	Characteristic	P-value
Latent class group 1, 2, 3 or 4	Age	0.000
	Nationality	0.007
	Gender	0.102
	Education level	0.184
	Household income level	0.377
	Household size	0.056
	Prior CPC knowledge	0.021
	CPC experience level	0.040
	Living status	0.589
	Tenure status	0.006

Table 24: Overview personal characteristics LC groups

Characteristic	LC group 1	LC group 2	LC group 3	LC group 4
Age	**Percentage**	**Percentage**	**Percentage**	**Percentage**
24 years or younger	28.1	23.3	6.1	5.6
25-34 years	18.8	10.0	6.1	2.8
35-44 years	9.4	16.7	18.2	8.3
45-54 years	14.1	0.0	12.1	13.9
55-64 years	10.9	20.0	24.2	25.0
65-74 years	12.5	13.3	33.3	41.7
75 years or older	6.3	16.7	0.0	2.8
Nationality	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Dutch	100.0	100.0	90.9	100.0
Not Dutch	0.0	0.0	9.1	0.0
Prior CPC knowledge	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Yes	64.1	70.0	87.9	86.1
No	35.9	30.0	12.1	13.9
Experience with CPC	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Heard of CPC but no interest in it.	17.2	13.3	6.1	2.8
Only interested in CPC	6.3	3.3	3.0	5.6
In initiation phase	9.4	13.3	21.2	13.9
In development phase	3.1	13.3	18.2	22.2
Living in dwellings realized with CPC	28.1	26.7	39.4	41.7
Tenure status	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Owner-occupied	93.3	84.8	88.9	93.3
Rental	6.7	15.2	11.1	6.7

The results for LC group 3 are used to determine the willingness to pay and the suitability scores of plots for the CPC community. The reason that the results of LC group 3 are chosen is that the respondents in this group have the most knowledge and experience with CPC projects (87.9% had prior CPC knowledge, 78.8% of those people had prior CPC experience). Even though respondents in LC group 4 have almost similar levels of CPC knowledge and experience, this group has not been chosen since it is more strongly focused on respondents ages 45 and older.

Willingness-to-pay

The coding of the LC model had to be adjusted to determine the willingness-to-pay of the CPC community (based on LC group 3) for several attributes. The LC model had to be changed from a model based on effect coding to a model based on the original values. This allows the relative increase or decrease of the utility score per price increase to be determined. The results of this LC model can be seen in appendix O. From this model can be concluded that for every increase in price (in € 1000), the utility score decreases with a factor of -0.00937. The willingness-to-pay was determined by dividing the negative of the coefficient of the attribute level by the utility score of the price. An overview of all the willingness-to-pay results can be found in appendix P. it was observed that people are willing to pay most money for a plot that is located in a very green area (up till 258,500 Euro's extra). Based on the mean price of a home (432,000 Euro's), it could be concluded that the price is slightly over-estimated in the model.

5.4. Conclusions

From the MNL model output is concluded that the higher the price of a location, the lower the attractivity. This finding agrees with the literature. Furthermore, all models showed that the higher the level of greenery in a neighborhood, the greater the attractivity of the location. Regarding the distance to public transport, the results demonstrate that residents prefer locations not too far away (more than 10 minutes walking) but also not too close to them (less than 5 minutes walking). A surprising result was found for the proximity to the cycling network, as people tend to prefer locations as far away from it, possibly due to nuisance of the surrounding traffic. The distance to the supermarket was mostly found not to be a significant contributor to locational decision making, which is in contrast with the literature. In the LC model was seen that there are two latent class groups that have the largest percentage of respondents with CPC experience. The preferences of these people for location related attributes however differs. It was observed that respondents with more CPC experience either strongly prefer rural (LC group 3) or inner city (LC group 4) locations. Respondents with more CPC experience that prefer rural locations, also prefer locations within a ten minute walking distance to a PT stop, have the strongest preference for locations in highly green neighborhoods and prefer the possibility of having outdoor communal spaces. Respondents with more CPC experience that prefer inner city locations only strongly prefer to have the possibility of having both types of communal spaces (indoor and outdoor). More experienced CPC respondents that prefer inner city locations thus have fewer preferences in locational decision making than any other group. It can furthermore be seen that an increase in CPC experience results in having no significant preferences regarding the proximity of the location to the closest supermarket and the cycling network. Having no significant preference for the distance to the closest supermarket is in contrast with the literature.

6. Suitability score determination

In this chapter, the weights determined in the latent class model for group 3 were applied in a land suitability assessment. The output from this LC group was used since it has the highest percentage of respondents with CPC experience and was less focused on respondents of ages 45 and older. The suitability assessment followed the methodology described in subsection 3.3. The suitability assessment resulted in a dataset containing all plot information and suitability scores that will be used in the tool development. In this chapter, the evaluation criteria are briefly summarized, the attribute level weights are explained, the individual suitability scores are determined and an exemplary output is given.

The suitability assessment included the attributes: price of the plot, level of urbanity, distance to closest public transport stop and supermarket, level of green in the neighbourhood, distance to the cycling network and the possibility of realizing communal spaces. Based on the stated choice experiment and discrete choice analysis, all seven attributes had three attribute levels and every attribute level had a specific weight. Relevant spatial data was extracted for all the attributes for every plot that remained after the general exclusion assessment (see subsection 3.3.). Applying the weights from the latent class model helped answer the question: what are the suitability levels of plots used for CPC development?

6.1. Determining the individual suitability scores

In this subsection, for all seven attributes the attribute levels and attribute level weights are given. Furthermore, for every attribute it is explained how the individual, attribute related, suitability score was determined.

Price

The LC model output for LC group 3 as presented in appendix O was used to include the attribute level weights for the price of the plot in the suitability analysis. From this model it can be concluded that for every increase in price (in 1000 Euros), the utility score decreases with a factor of -0.00937. As a starting point, a price of 400,000 Euros was given a weight of 0.461. This starting point was used since in the effect coding based model, the only significant price level for LC group 3 was for the level of 400,000 Euros. The following weights were used in the suitability analysis: if the price of the ground is 400,000 Euros, a weight was given of 0.461. If the price of the ground is below 400,000 Euros, the weight of the plot had a value of 0.461 + ('Difference with 400,000 Euros' * 0.00937 / 1000). Likewise, if the price of the ground is above 400,000 Euros, the weight of the plot had a value of 0.461 – ('Difference with 400,000 Euros * 0.00937 / 1000). For this attribute, a maximum acceptable price was set, since otherwise the price attribute would be too dominant in the overall suitability score. This was necessary since extremely large plots were present in the layer which lead to extremely low suitability scores. In this situation, the maximum price for the plot was set at 1.5 million. All plots that had a calculated price of more than 1.5 million Euros were given a score of -9999, indicating a false score.

Level of urbanity

In the stated choice experiment, the level of urbanity had the attribute levels: inner city, edge of the city or rural locations. The urbanity data from the CBS however differs, since this data consists of areas with ranges 1 to 5, where 1 is very strongly urban and 5 is not urban. Therefore, in the CBS data an urbanity level with a value of 1 was used for the inner cities (SCE: 'Binnenstad'), urbanity levels 2 and 3 were used for locations in the outskirts or suburbs (SCE: 'Rand van de stad') and urbanity levels 4 and 5 were used for locations in the rural landscape (SCE: 'Dorp of platteland'). If a plot was located in an area with urbanity level of 1, this resulted in a weight of -2.107. Plots in areas with urbanity levels 2 and 3 were given a weight of 0.468 and plots in areas with urbanity levels 4 and 5 were given a weight of 1.639.

Distance to closest public transport stop

In the stated choice experiment and discrete choice analysis three attribute level weights were determined. These were that a public transport stop is at a five minutes walking distance (400 meter), ten minutes walking distance (800 meter) and 15 minutes walking distance (1200 meter) from the plot. According to the results of the LC model, the weight for a distance of < 400 meter was 0.064, the weight for a distance of 400 < X < 800 meter was 0.521 and for a distance of 800 < X < 1200 meter the weight was –0.585. Finally, locations with a distance of ≥ 1200 meter were not taken into consideration in this suitability analysis, by giving them a score of -9999. This had been done since the weights for these distances had not been determined in the discrete choice analysis. Plots located at these distances were however not part of the general exclusion assessment, since in the tool, users might still want to include these locations in their personal suitability assessment.

Distance to closest supermarket

The three attribute levels determined for this attribute were that a supermarket can be located at a five minutes walking distance (400 meter), five minutes cycling distance (1500 meter) or at a distance of more than five minutes cycling distance (more than 1500 meter) from the plot. According to the LC model results, the weight for a distance of < 400 meter was set at -0.385, the weight for a distance of 400 < X < 1500 meter was set at 0.072, the weight for a distance of 1500 < X < 3000 meter was set at 0.313 and finally, locations at a greater distance were not taken into consideration by giving them a score of -9999. This had been done since the weights for these distances had not been determined in the discrete choice analysis. Plots located at these distances were however not part of the general exclusion assessment, since in the tool users might still want to include these locations in their personal suitability assessment.

Level of greenery

The attribute levels for this attribute were that the location is situated in a neighborhood that has a high level of greenery, medium level of greenery or low level of greenery. According to the LC results, locations in a neighborhood with a high level of greenery received a weight of 2.422, areas with a medium level received a weight of 0.078 and areas with a low level received a weight of -2.499.

Distance to cycling network

The three attribute levels for this attribute were that the plot has an excellent connection with the cycling network (within 600 meters), a good connection with the cycling network (between 600 and 1500 meters) or a poor connection with the cycling network (more than 1500 meters). According to the results of the LC model, the weight for a distance of < 600 meter was -0.252, the weight for a distance of 600 < X < 1500 meter was set at 0.024, for a distance of 1500 < X < 3000 meter the weight was set at 0.228 and finally, locations with a distance of ≥ 3000 meter were not taken into consideration by giving them a score of -9999. This had been done since the weights for these distances had not been determined in the discrete choice analysis. Plots located at these distances were however not part of the general exclusion assessment, since in the tool users might still want to include these locations in their personal suitability assessment.

Possibility of communal spaces

The attribute levels for this attribute were that the plot allows the realization of only indoor communal facilities, only outdoor communal facilities or both communal facilities. The possibility of communal facilities depends mostly on the size of the plot. Determining the plot size for every attribute level is explained in subsection 3.3. In this suitability assessment, the plot sizes are determined for one example. The assumptions were that in total 10 dwellings will be built, all of which need to be minimum 90 sqm in size. It was furthermore assumed that 100 sqm was needed for all indoor communal spaces and 200 sqm was needed for all outdoor communal spaces. All these dwellings were to be built on the ground floor. These assumptions translated to a plot area per dwelling ranging from 137.5 to 157.5 sqm. In the current CPC overview (see file: *Overview_current_CPC_projects*), it was found that current CPC projects in The Netherlands range from approximately 110 to 200 sqm per dwelling. Therefore, it can be concluded that the assumptions made can be considered true to reality. Filling all the assumptions in formula 9 gives:

$$Minimum\ plot\ area\ (only\ indoor\ communal) = 10 * \left(\frac{90}{1} + 37.5\right) + \frac{100}{1} + 0 = 1375 \text{ m2}$$

$$Minimum\ plot\ area\ (only\ outdoor\ communal) = 10 * \left(\frac{90}{1} + 37.5\right) + \frac{0}{1} + 200 = 1475 \text{ m2}$$

$$Minimum\ plot\ area\ (all\ communal) = 10 * \left(\frac{90}{1} + 37.5\right) + \frac{100}{1} + 200 = 1575\ m2$$

The calculated plot areas were then considered in combination with the attribute levels. Plots with an area smaller than 1375 sqm were not considered in the suitability analysis since these do not allow any communal spaces to be developed. Plots with an area between 1375 and 1475 m2 had a weight of -1.063, plots with an area between 1475 and 1575 sqm had a weight of 0.707 and plots with an area greater than 1575 sqm had a weight of 0.355.

6.2. Determining the overall suitability score

All individual, attribute related, suitability scores were determined. An overview of all the used expressions can be found in appendix Q. The formula to determine the overall suitability score is the result of the summation of all individual, attribute related, suitability scores. If any individual score was equal to -9999 (an incorrect value), this mean that the plot is not suitable for development and should be excluded from the suitability analysis. The used expression to determine the overall suitability score is:

```
CASE
WHEN  "UtilityPT" = -9999 OR  "UtilityPri" = -9999 OR  "UtilitySup" = -9999 OR  "UtilityCyc" = -
9999 OR  "UtilityAre" = -9999 OR  "UtilityUrb" = -9999 THEN NULL
ELSE  "UtilitySup" + "UtilityPri" + "UtilityPT" + "UtilityGro" + "UtilityCyc" + "UtilityAre" +
"UtilityUrb"
END
```

6.3. Interpreting results

The results of applying the case formula can be seen in Table 25. The ranges shown in table 25 are based on equal intervals, where the lowest found score was equal to -14.7 and the highest found score was equal to 5.5. Based on the results of the suitability model can be seen that of the 418,407 possible plots, only 82,100 could be considered as suitable, equal to 19.6% of all plots. One possible reason for this is that several conditions (maximum distances) were too strict. However still, it could be seen that there are still over 7500 plots that have an excellent score in the used suitability assessment. In general, of all found suitable plots, half of them have a percentage score of 60% or higher. However, if only empty plots are considered, it can be seen that the total number of suitable plots decreases dramatically, as the total number of suitable plots decreases to 5299 (1.3%).

Table 25: Statistics results suitability analysis

Class name	% score	Range values	Count	% of all suitable plots
Poor	0-20%	-14.7 to -10.6	1111	1.4
Fair	20-40%	-10.6 to -6.6	9417	11.5
Good	40-60%	-6.6 to -2.5	28,334	34.5
Very good	60-80%	-2.5 to 1.5	35,373	43.1
Excellent	80-100%	1.5 to 5.5	7865	9.6

A fraction of the visual output of the suitability assessment can be seen in figure 12. The fraction that is presented shows the southern districts of Eindhoven. This fraction has been chosen since a variety of suitability scores can be seen. Furthermore, in figure 13, it is further zoomed in on the neighbourhood Gestel in the southwest of Eindhoven. In the suitability maps, plots are visualized that were extracted from the general land use plan. In reality, these plots might be smaller, which is where cadastre boundaries can provide the real plot sizes. In the maps, red filled polygons indicate plots that can be considered suitable, but, based on the weights, are of weaker locational quality than the plots filled with green. If a map is needed that shows only plots that are not occupied by one or more buildings, then added steps need to be taken (see appendix D). The result of these added steps can be seen in figure 14. This map is easier to interpret and tells us that even though the number of suitable plots are reduced, there are still some plots found suitable that have no buildings on them.

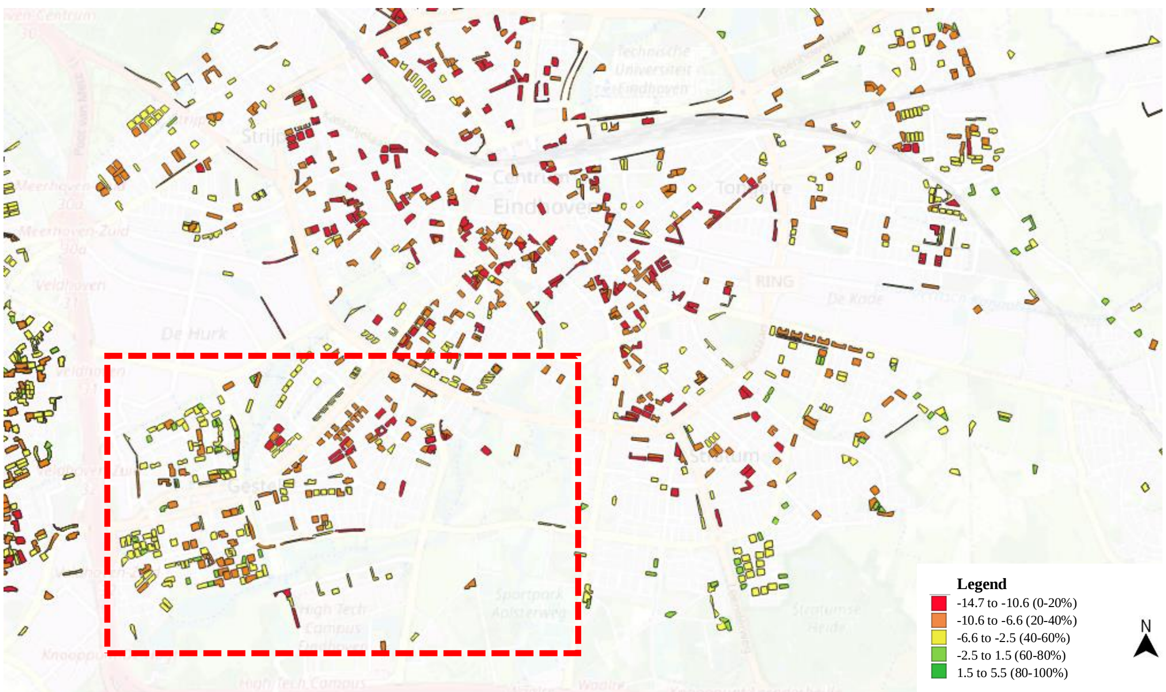

Figure 12: Suitability map southern part Eindhoven

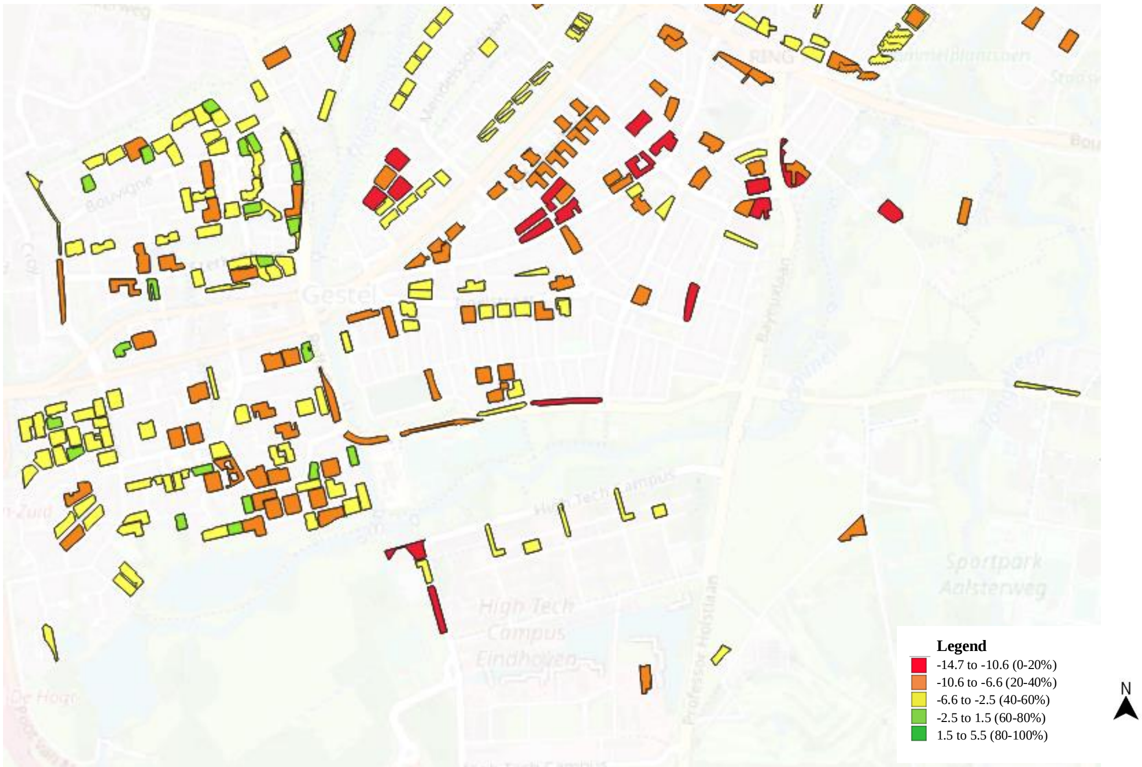

Figure 13: Suitability map zoomed in on indicated neighbourhood (Gestel) in Eindhoven

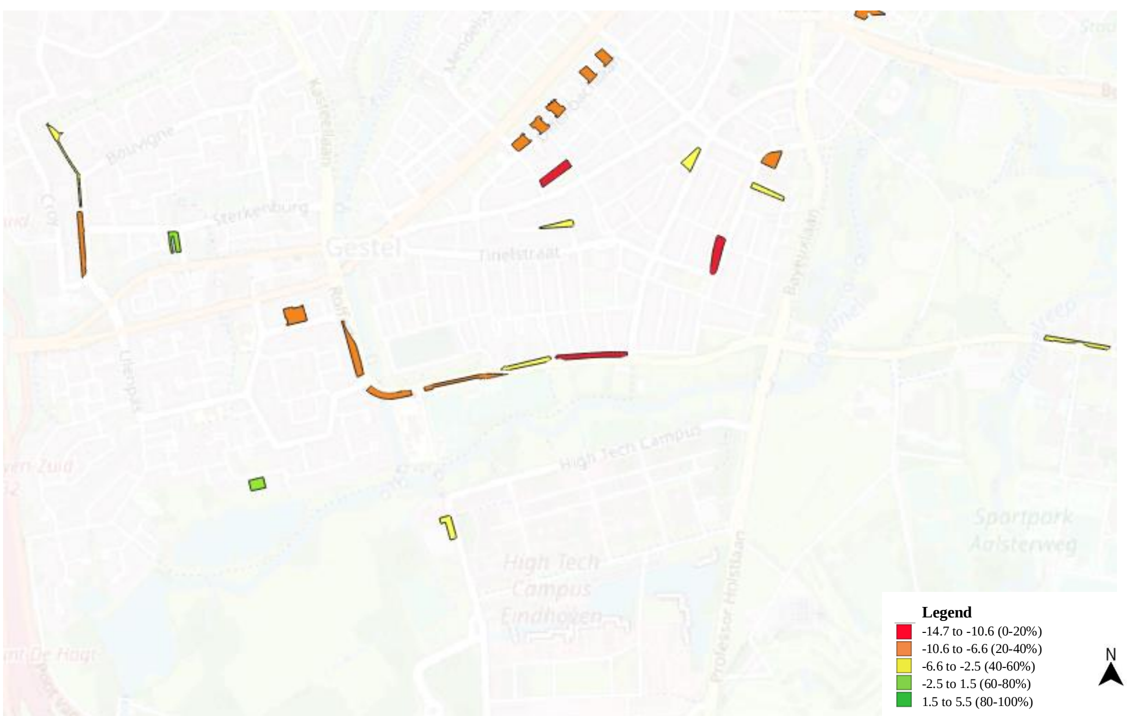

Figure 14: Suitability map Gestel, only plots that are not occupied by one or more buildings

7. Tool development

The next and final task in this thesis was to build an interactive suitability tool. In this chapter, the relevance and objective of this tool are highlighted, as well as its design and functionalities.

7.1. Objective and relevance

The goal of this tool is to convert the performed suitability analysis in chapter 6 into an interactive suitability model that can be used by all people interested in CPC development that are looking for a suitable location to develop. Users should be able to use this tool a) to see if there are any development plots available within their preferred scope and if they found multiple plots available, b) to assess what plots can be considered most suitable for their CPC group. The user of the tool will act out of interest of their CPC group. This tool can therefore help CPC groups in finding a location for developing their new homes through CPC by guiding them in one of the first steps – location identification. At the moment, a time span of more than two years is not unthinkable for finding a location to develop. The aim of the developer is therefore that with the use of this interactive tool, CPC interested people can reduce the time span of their search of finding an ideal location to develop.

7.2. Build-up

The developed tool consists of two components: an online and offline component. An overview of these components can be seen in figure 15. The online component functions to answer the question "Are there any suitable plots?". This tool component has been made with the ArcGIS WebApp Builder software (ESRI, n.d.-a). All necessary functionalities to find any suitable plots can be found in the more detailed explanation found in section 7.3. In this section, not only the functionalities can be found, but also how they were built with the software. The final result of this part of the tool development is an online interactive tool in which filters could be applied for a personal exclusion assessment. This tool is easily accessible through an internet link. No additional software is required.

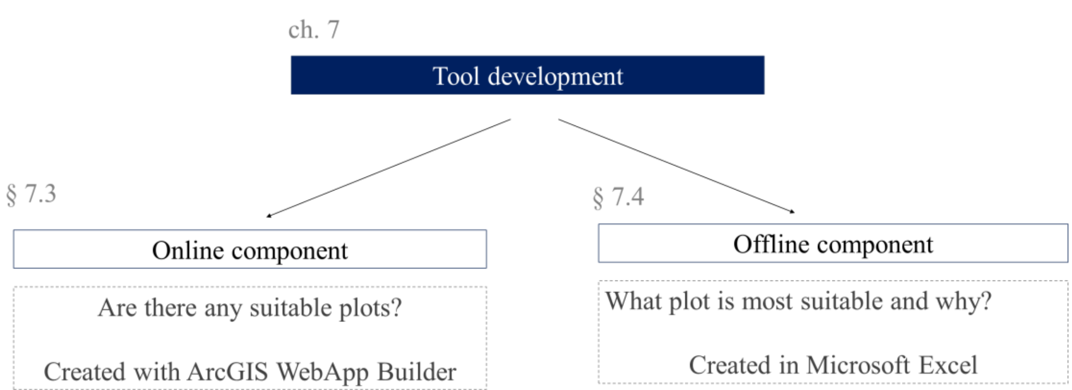

Figure 15: Overview tool development components

If more than one suitable plot has been found in the online component of the tool, the next step is to answer the questions: what are the suitability level of the found plots and what plot is most suitable? The offline component can help answer these questions. This offline component consist of a GIS based suitability assessment. Assessing which plot is most suitable can be done with the Microsoft Excel software. All necessary functionalities of this assessment and how they were built can be found in section 8.3. The final result of this part of the tool development is that, based on the set attributes and weights, users are able to assess for every plot the overall suitability score and the individual, attribute related, suitability scores. The Excel file can be downloaded through the information page of the online tool.

An important note is that the included attributes in both parts of the tool are similar to the ones that were included in the discrete choice analysis and suitability analysis. Thus, in total seven attributes can be used to assess whether a plot is suitable. In finding the most suitable plots, the default attribute weights are based on the results of the analysed LC model for LC group 3. The default weights are thus equal to the used weights in chapter 6. The calculated weights are henceforth called 'default weights' since in the tool, the user is able to modify these weights based on the preferences of their CPC group. This will be further explained in section 7.4.

7.3. Online component

In this section all functionalities necessary to find any suitable plots are explained. How these functionalities were built in the ArcGIS WebApp Builder software can be found in appendix R. First, the necessary software and data steps are explained. Then the functionalities are explained, followed by the design of the interactive tool.

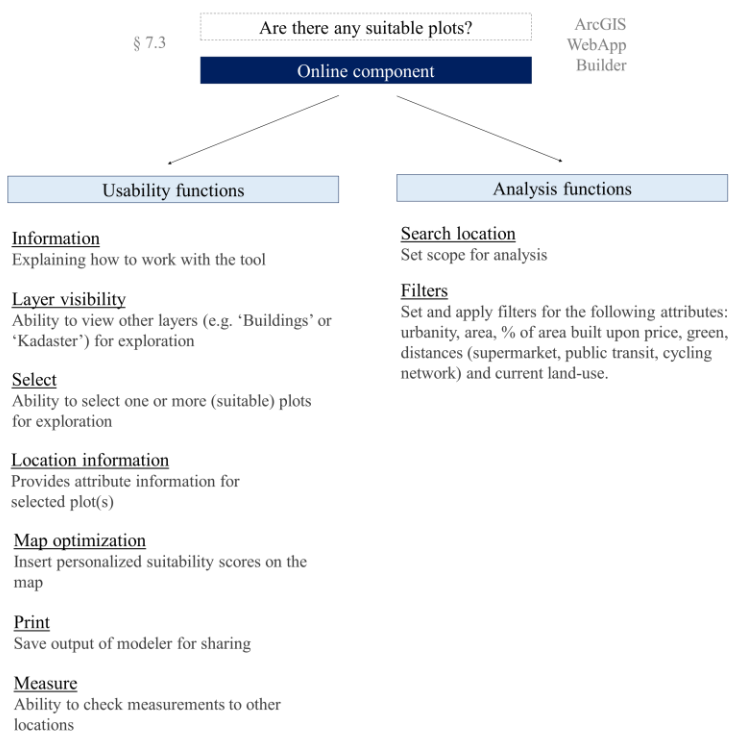

Figure 16: Functionalities online tool

7.3.1. Functionalities

The functionalities of the online component can be found in a web app and are the most important aspects of the web map. An overview of all functionalities can be seen in figure 16. It can be seen that there are two types of functionalities: those that can be used for the usability and those that can be used for the analysis. All functionalities are explained in the order that they were built and should be used by the user.

Information

The first functionality that can be used is to read through important information. In this functionality, users can read about what the tool has been built for, how it can be used, how to download the Microsoft Excel file for the suitability assessment and tips (e.g. to determine the minimum area required for their development) and notes (what attributes are included and how plots are defined). All this information has been added to the tool with the “About”-widget. The text added to the web app can be found in appendix S (note: this text is presented in Dutch).

Search location

Second, users need to select their area of interest. The area of interest is equal to the extent visible to them in the web map. They can adjust their area of interest either by panning and zooming in or out manually, or by searching their desired location in the search bar. This search bar had already been added to the web map with the “Search”-widget.

Filters

The third and perhaps most important functionality of this first part of the web development is to set filters. These filters automatically remove unsuitable plots from the visible layer extent based on personal preferences. Filters can thus be used for personal exclusion assessment. In total, eleven filters can be applied by the user in the web map. The filters that can be applied include: 1) the minimum area of the plot, 2) the maximum area of the plot, 3) the maximum percentage of the plot with buildings on them, 4) the maximum (estimated) price of the plot, 5) the desired levels of urbanity, 6) the maximum distance to the nearest supermarket, 7) the maximum distance to the nearest public transport stop, 8) the maximum distance to the cycling network, 9) the desired level of greenery in the area, 10) what current landuse (in the broader sense) the plot should have and 11) what more detailed, current landuse the plot should have.

These filters have been added to the web map with the “Filter”-widget. In this widget it is important to select “Display features that match all of the features”. Furthermore, for every filter, the label (displayed text), icon and expression need to be set. The settings for all used filters can be found in appendix S.

Layer visibility

In the tool, the user is able to see and interpret various data layers. These layers include the location of the cycling network, public transport stops, supermarkets, the level of green in the neighbourhood, urbanity, the cadastre boundaries layer, the layer containing the location of all existing buildings and what plots are considered suitable (the default visible layer). It does not include information whether there are already buildings present on these plots or whether the plots can only be obtained in full or if also fractions can be bought (cheaper than buying the whole landuse plot). Therefore, by selecting the building and cadastre boundaries layer, users can see whether their found plots are truly available for (greenfield) development.

Select

Users might want to view their individual attribute suitable scores (e.g. the level of green in the area). To do this, first the concerned plots need to be selected. This can be done with the "Select"-widget. This widget allows more than one plot to be selected.

Location information

If plots are selected, their attribute information can be accessed through the "Location-information"-widget. This widget automatically shows the different values for e.g. the different distances to the supermarket or public transport stop. It also shows the attribute 'FID' (the identification number of the plot), which is necessary later in the suitability assessment.

Map optimization

Users might want to include the results of the Excel-based location assessment into the map. They might want to do this to create a visual representation of the suitability assessment results and to share this representation. This was done in the "Map optimization" function. Here, users can manually change the suitability score percentage. Since the plots are visualized based on their suitability score percentage (with the same ranges as in chapter 6), changing the percentage scores can automatically the visual output of the results.

Print

Users might want to export the generated (suitability) maps so that they can either share them or use them later. This was made possible with the "Print"-widget. With this functionality, they can both choose the lay-out of their print (including the size, unit of measurement and if to include the legend or attributes) and the format they wish to export into.

Measure

Users might want to check certain values for distances, as they might think it is false or want to check them out themselves. This was made possible with the "Measure"-widget. With this functionality, they can both measure certain distances (in meters) or areas (in square meters).

Design

The design of the web app can be seen in figure 17. On the left, all functionalities can be found in the top of the screen. Once a functionality is selected, the necessary information becomes visible in the tab below it. It can be seen that the order of using the tool can be seen back in the visual design of the model: the functionality that should be used first is on the left. The visibility extents can be altered in the top left corner of the map by use of the zoom-, search by (or my) location-, legend- and layer visibility functions. Visuals of how the tool looks like once certain functions have been selected can be found in appendix S.

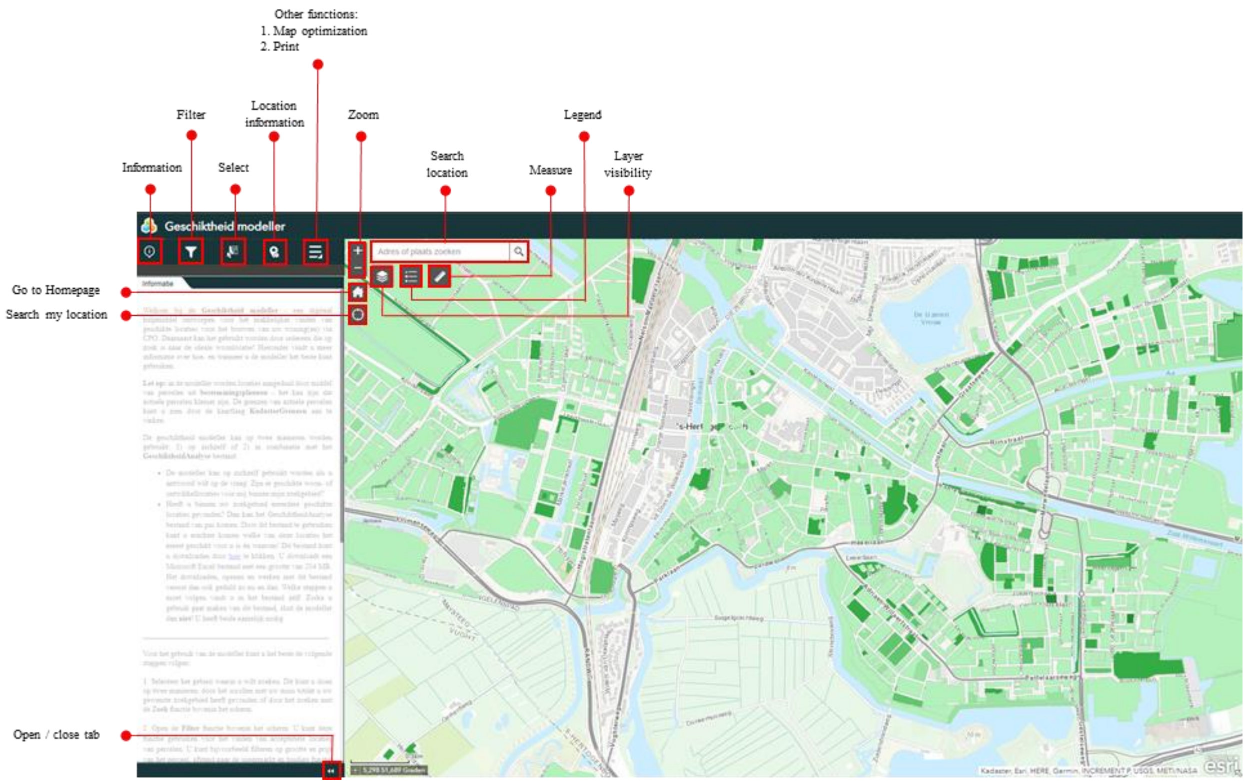

Figure 17: Visual online tool for filtering suitable plots

7.4. Offline component

An Excel document for interactive suitability assessment can be used if one or more suitable locations are found in the online component of the tool. This document can be used to assess what suitability score can be connected to the plots of interest. In this document, various functionalities can be used to reach that goal. These functionalities are explained, followed by the design of the document.

7.4.1. Functionalities

Similar to section 7.3, the functionalities that need to be used for this assessment can be categorized in functionalities for usability or analysis purposes. Again, these functionalities are explained in their order of usage. An overview of all these functionalities present in the suitability assessment document can be found in figure 18.

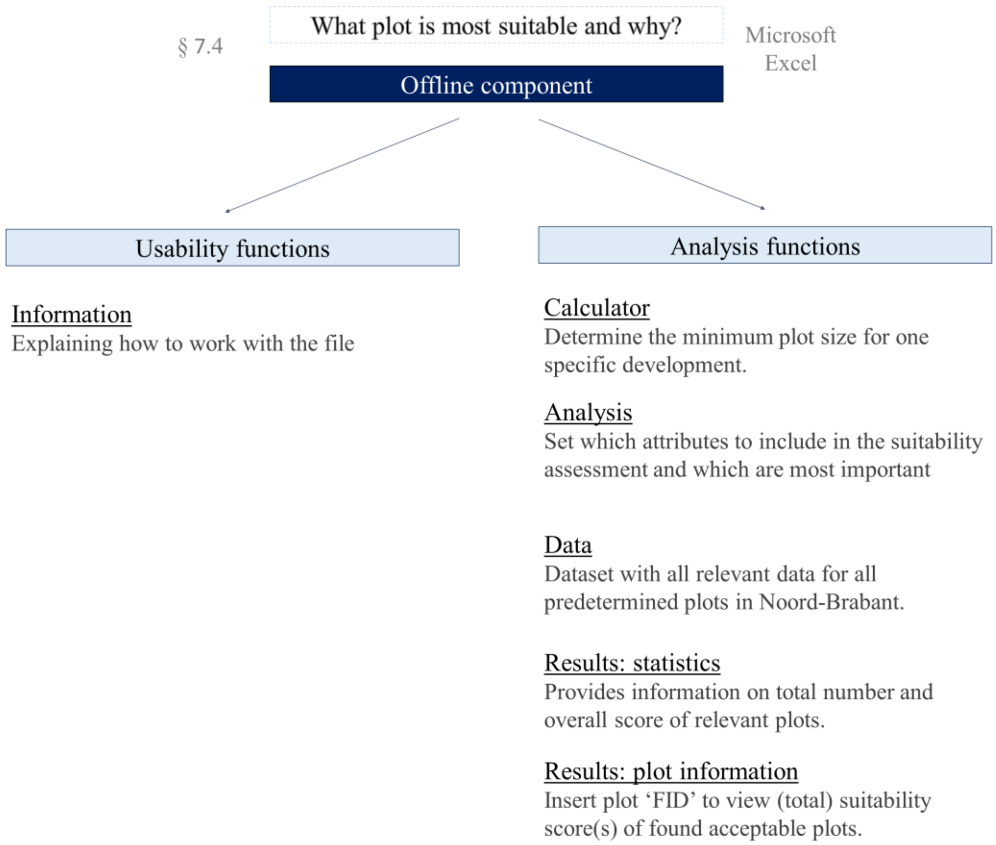

Figure 18: Functionalities interactive suitability file

Information

The first functionality is the provision of information. This will be done in the first worksheet in excel that is automatically visible when opening the document. In this worksheet, general information can be found regarding the contents of every tab. A more detailed overview of the information showed on this page can be found in appendix T.

Calculator

On the second page of the document, the calculator function can be found. This is an optional function in which users can calculate the minimum area necessary for their CPC development project. In this calculator, the minimum plot area is based on several user-defined input values previously defined in subsection 6.2.3. These are 1) the number of dwellings to be built in the project, 2) the desired area per dwelling, 3) total desired area of communal indoor facilities, 4) total desired area of (communal) outdoor facilities and 5) the number of floors in which the dwellings and indoor communal facilities can be found. The visual contents of the calculator page can found in appendix T. Calculating the area can be done using formula 13. In this formula, the values defined by the user are indicated in bold.

$$Minimum\ plot\ area = \frac{(\boldsymbol{\#dwellings} * \boldsymbol{area\ per\ dwelling}) + \boldsymbol{area\ indoor\ facilities}}{\boldsymbol{\#floors}} + parking\ area + \boldsymbol{area\ outdoor\ communal\ space}) \quad (13)$$

Analysis

The analysis worksheet in the document allows users to determine themselves what attributes (of the predefined list of attributes based on the stated choice model) to include in their suitability assessment. Furthermore, they can indicate what attributes they value either more or less important. By default all seven predefined attributes are included and the weights are based on the output of the LC model analysis. If the user wishes to exclude an attribute from their suitability analysis, they can do this by clicking on the yellow filled cell in table A of figure 21 and selecting 'No' instead of 'Yes'. If an attribute is excluded from the suitability assessment, all attribute level weights are automatically set to 0. If the user values a specific attribute as either more or less important, they can alter the level of importance for every included attribute. For every attribute, they can indicate if they do not value the attribute at all (attribute level weights are set to 0), wish to use the default values (attribute level weights do not change) or value an attribute as either more or less important. If the user values an attribute as more important, then the attribute level weights are multiplied by a factor 2 (slightly more important) to 5 (much more important). If the user values an attribute as less important, then the attribute level weights are divided by a factor 2 (slightly less important) to 5 (much less important). For an overview of how this would affect the attribute level weights, see appendix T. Using the default settings based on the SCE is done since this makes the tool easier and faster to use. Otherwise, users would need to rate 21 attribute levels before conducting the analysis. An example of how to include attributes and set their level of importance can be seen in figure 19.

A. De volgende variabelen wil ik meenemen in de analyse	Meenemen?
Grootte perceel	Ja
Prijs perceel	Ja
Stedelijkheid	Ja
Groen in de omgeving	Ja
Afstand dichtstbijzijnde OV halte	Ja
Afstand dichtstbijzijnde supermarkt	Ja
Afstand tot fietsnetwerk	Ja

B. De volgende variabelen wil ik aanpassen	Mate van belang
Grootte perceel	Gebruik standaard waardes
Prijs perceel	Gebruik standaard waardes
Stedelijkheid	Gebruik standaard waardes
Groen in de omgeving	Gebruik standaard waardes
Afstand dichtstbijzijnde OV halte	Gebruik standaard waardes
Afstand dichtstbijzijnde supermarkt	Gebruik standaard waardes
Afstand tot fietsnetwerk	Gebruik standaard waardes

Variabele onbelangrijker
Variabele redelijk onbelangrijker
Variabele enigzins onbelangrijker
Gebruik standaard waardes
Variabele enigzins belangrijker
Variabele redelijk belangrijker
Variabele belangrijker
Variabele veel belangrijker

Figure 19: Interactive analysis-options

Furthermore, users can adjust the land prices per sqm used in the analysis based on local or more specific information. By default these are set to the results of the land price analysis as seen in appendix P. However, these prices differ per municipality and therefore, need to be adjustable per project. Interactively adjusting these prices per sqm is done similarly to changing the attribute importance. Also, in the analysis page, the user is advised to set a maximum acceptable price of the plot. This has been advised since larger sizes and subsequent prices of the plots would otherwise dominate the other attributes in the suitability analysis. Users can also choose to set other maximum acceptable attribute values. These maximum acceptable attribute values can also be called personal exclusion criteria. Users can decide to have a maximum acceptable distance from the plot to a public transport stop, the supermarket or to the cycling network. An overview of the visual contents of the analysis page can be found in appendix T.

Data

The data worksheet is the main part of the interactive suitability assessment document. In this page, all set filters, what attributes to include and the attribute level weights are applied to the data. The original data file used for the interactive suitability assessment is the final vector based dataset created in chapter 6. This dataset has been imported in the Microsoft Excel document and has been converted into the Excel format. In the data page, a large number of columns exist that represent different attributes of a plot.

In total, eleven columns need manipulation. All formulas applied to the columns in the assessment document can be found in appendix T. To determine the suitability score for the attribute 'price', first the land price per sqm need to be determined, which depends on the distance to the nearest city centre. The total price of the plot will then be calculated by multiplying the total plot area with the land price per sqm. The total price of the plot will automatically change once the user changes the price per sqm, which also automatically changes the calculated utility score for the price of the plot. Then, for all distance criteria, formulas need to be applied that allow a maximum value. The applied formulas for all distance criteria (to supermarket, public transport and cycling network) can be found in appendix T. For both the level of greenery as – urbanity, similar formulas have been applied. Here, for every criteria value, the formula should include the set filter. These formulas can be found in appendix T. The last criteria that requires an automatic formula is the area of the plot that allows possibilities of communal spaces. This formula uses predefined input that are the result of the "Calculator" page and can be found in appendix T. The total utility score also needs a formula that calculates automatically the new score once a weight is changed or criteria is excluded. The formula can be found in appendix T and is similar to the formula used in chapter 7.

Results

The results worksheet of the interactive suitability assessment document consists of two components: the statistics and the information generation for found suitable plots.

Results: Statistics

In the statistics part of the results worksheet, the user can find the following information: how many plots are there in the province Noord-Brabant, how many of them are suitable and how many of them are unsuitable. Furthermore, a table is provided in which they can assess the relative (% scores) scores of all suitable plots. For every 10% interval, the total number of suitable plots with that score can be seen. Users are furthermore notified that they can use these statistics to assess the influence of various location demands or wishes. The visual output of this component can be found in appendix T.

Results: Plot Suitability Information generator

The plot suitability information generator can be used to assess the suitability levels of the found plots, to find what plot is most suitable and why. First, information is provided to the user regarding how to interpret the results. To see whether a plot is suitable, the FID has to be copied into the correct cell. By using a 'lookup-function' in Excel, the suitability score(s) can be seen. Interpreting the results can best be done with an example, as shown in figure 20. Interpreting the results will be done by individually answering several questions.

Statistieken

Hier kunt u zien hoeveel percelen in de provincie Noord-Brabant voldoen aan uw wensen. Daarnaast kunt u zien hoe goed de percelen scoren a.h.v. de (door u gekozen) toegepaste scorewaardes. U kunt deze informatie gebruiken om te zien wat voor effect een bepaalde wens heeft op het totaal aantal geschikte percelen.

Totaal aantal percelen	418034
Waarvan ongeschikt	99820
Waarvan geschikt	*318214*

Percentage ongeschikt	23.88%
Percentage geschikt	*76.12%*

% van MaxScore	Aantal	% van totaal
0-10%	56	0.0%
10-20%	1034	0.3%
20-30%	7274	2.3%
30-40%	12158	3.8%
40-50%	16748	5.3%
50-60%	25271	7.9%
60-70%	42634	13.4%
70-80%	79318	24.9%
80-90%	113356	35.6%
90-100%	20365	6.4%
Totaal	318214	100.0%

Informatie gevonden percelen

Mocht u in de *Geschiktheid modeller* meerdere percelen hebben gevonden die voldoen aan uw wensen, kunt u hieronder zien hoe goed ieder perceel scoort a.h.v. de (door u gekozen) variabelen. Dit doet u door de het perceel te selecteren in de *modeller* en de *FID* te kopiëren. Voor uw gemak kunt u de namen van de percelen wijzigen, bijvoorbeeld naar de straatnaam. Deze kunt u hieronder invullen in de geel gemarkeerde velden. Vervolgens kunt u zowel de totaalscore als individuele scores zien. Mocht de totaalscore een waarde hebben van *FALSE* , dan is het perceel ongeschikt a.h.v. de door u gemaakte keuzes. Waarom het perceel ongeschikt is, kunt u vervolgens zien aan de individuele scores. Mocht één van deze een *FALSE* score hebben, dan is deze locatie eigenschap de reden dat het perceel is afgekeurd. Mocht het zijn dat het perceel wordt afgekeurd door de score van de prijs van het perceel, is het belangrijk om te herinneren dat de percelen zijn gebaseerd op bestemmingsplannen. Wellicht als u slechts een kleiner deel van het perceel kunt bemachtigen (zie de kaartlaag "Kadastergrenzen" in de *modeller*) - kan het perceel alsnog geschikt verklaard worden.

	FID	TotaalScore	% van MaxScore	ScoreSupermarkt	ScorePrijsPerceel	ScoreOV	ScoreGroen	ScoreFiets	ScoreOppervlak	ScoreSted
Perceel 1	9753072	-12.735	44.2	-0.385	-13.448	0.064	0.078	-0.252	0.355	0.468
Perceel 2	10881518	-12.890	43.8	-0.385	-13.603	0.064	0.078	-0.252	0.355	0.468
Perceel 3	10881513	-2.061	70.4	-0.385	-2.774	0.064	0.078	-0.252	0.355	0.468
Perceel 4	119314	FALSE	FALSE	0.313	FALSE	-0.585	0.078	0.024	0.355	1.639
Perceel 5		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 6		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 7		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 8		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 10		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 11		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 12		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 13		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 14		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 15		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Min. score ->	-30.79105644	0%	-0.385	28.11	-0.585	-2.499	-0.252	-1.063	-2.107
	Max. score ->	10.04	100%	0.313	0.00	0.521	2.422	0.228	0.707	1.639

Figure 20: Information generator and results

Results: What plots are suitable?

This question can be answered by looking at the 'TotaalScore' column. If the plot has a value in this column which is not 'FALSE', they are considered suitable. A plot could have an overall 'FALSE' score if one of the included attribute suitability scores has a 'FALSE' score. An attribute suitability score is given a 'FALSE' score if the price of the plot or distance to e.g. the supermarket is greater than the set maximum acceptable value. In the example, it can be seen that plot 4 has a "FALSE" value for the price of the plot. Therefore, it could be concluded that this plot is unsuitable since the plot is too expensive. Thus, in the example, the first three plots are considered suitable while the last plot (with FID = 119314) is not suitable.

Results: What plot is most suitable?

This question can also be answered by looking at the 'TotaalScore'. The plot with the highest score in this column is considered the most suitable. In the example, it can be seen that plot 3 (with FID = 10881513) is most suitable since it has the highest 'TotaalScore' with 70.4%. This 'TotaalScore' can be interpreted as follows: if the 'TotaalScore' is 0% it means that the plot has the lowest possible overall suitability score, while a 'TotaalScore' of 100% means that the plot has the highest possible overall suitability score. A 'TotaalScore' of 70% thus means that 70% of the highest possible score is achieved.

Results: Why is a plot most suitable?

Answering this question can be done by looking at the included individual attribute suitability scores and assessing the differences between them. In this example, it can be seen that the three plots score similarly for six attribute suitability scores. Therefore, the difference in suitability for these plots are due to the price of the plot. It can be seen that plot 3 scored significantly better on the score of the price, concluding that plot 3 is most suitable since the price of the plot is much more attractive.

8. Case study

In this chapter the developed tool is used in practice by a case study. Before this case study is explained, the steps necessary to use the tool are explained. These steps are also conducted during the case study.

8.1. Order of steps

An overview of all necessary steps and their order can be seen in figure 21. Some of these steps need no explanation (e.g. open online suitability modeler) and some are optional (e.g. export results). All steps that need explanation are also explained in the 'Information' tab within the online modeler.

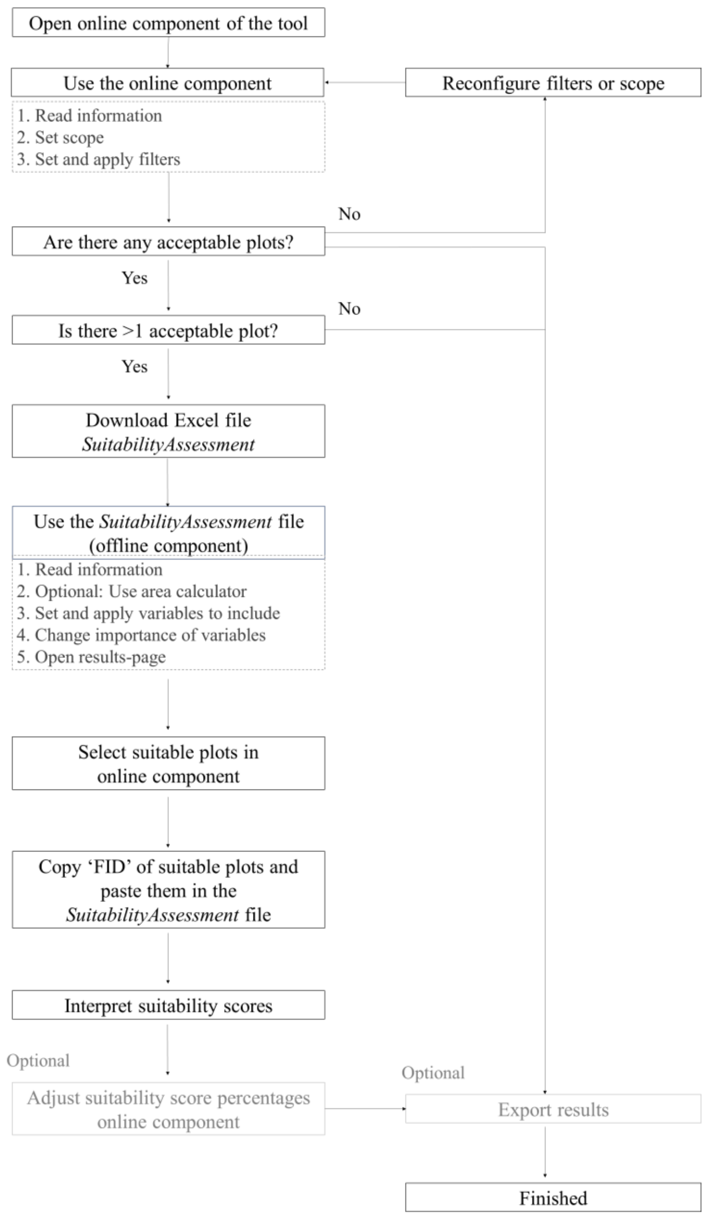

Figure 21: Steps to use the developed tool

Use the online component of the tool

The user should start with reading the information that is immediately shown on the left panel. This information is described in section 7.3 and highlights the steps that the user should follow. First, the scope must be set in the viewer. This scope is the area of interest in which the user hopes to find a suitable location for CPC development. After this, the user can set filters to find if there are any suitable plots in the area of interest. These filters help to answer the question: are there any suitable plots present in my area of interest? If the answer to this question 'Yes, there is one suitable plot present', then the Excel-based suitability assessment file can only be used if the user wishes to know the level of suitability of the found plot. If the answer to the question is 'No, there are no suitable plots present', then the user could choose to leave it at that or to reconfigure their filters or area of interest and search again for a suitable plot. This could be an iterative process. If the answer to the question is 'Yes, there are multiple plots found suitable', then the user could use the Excel-based suitability assessment file to assess the level of suitability of all found plots and find the most suitable plot. Finally, the user can decide to export the visual output of the tool for future use.

Use the Suitability Assessment file (offline component of the tool)

Users can use the Excel based suitability assessment file if one or more suitable plots in their area of interest are found. This document can be downloaded from the 'Information' tab in the modeler. In the file, users will be shown basic information on how to use the tool on the first worksheet called 'Information'. After this, the user can calculate the minimum area that the plot should have for their CPC development or directly go to the 'Analysis' worksheet. In this worksheet, the user can indicate what attributes they wish to include in their suitability assessment and how important they rate these attributes. In the 'Results' worksheet it is explained how they can interpret the results and how they can link the found plots in the modeler to the suitability assessment. This can be done by copying the plot attribute 'FID' (identification number) of the plot in the online modeler and pasting it in the appropriate field in the Excel-based document. The user is able to adjust the name of the plot in the document e.g. based on the street name. After copying all relevant plots in their appropriate fields, the user is able to see the overall suitability score and the individual, attribute related, suitability scores. With this information, the user can assess the level of suitability of the plots and find what plot is most suitable for their CPC project and why.

The next steps are all optional. The user could add the found (user-unique) suitability percentage scores to the map in the modeler to create a visual representation of the personalized suitability assessment. The color of the plot represents the suitability score on the map. Finally, the user can choose to export these results into different document types, such as images (.jpeg, .png) or .pdf files.

8.2. Results case study

In this section the results of a case study are given following the steps as described in section 8.1. In the case study, the tool is used by a respondent that is looking for a location for the CPC development for her CPC group. In this CPC group, the majority of the members are between 55 and 64 years old, are Dutch, have a medium to high education level and live in a high income household situated in a highly urban neighborhood located in the province Noord-Brabant. The current tenure status of their homes is owner-occupied and they exclusively live independently. At the moment, the members of the CPC group have no experience in CPC projects. The age, nationality and household income of the members of the CPC group fit in the latent class group 3. The weights included in the model are thus relevant for the CPC group of the respondent. The respondent and her CPC group are looking for a plot suitable for a CPC development located in the municipality Heusden, where at least 10 dwellings need to be built.

8.2.1. Using the tool

The respondent uses the tool according to the steps as explained in section 8.1. First, the respondent set the scope to the village Drunen, located in the municipality Heusden. Then the respondent applied the following filters:

a) A plot should have an area of minimum 1000 square meters;
b) A plot should be entirely free of buildings;
c) A plot can have a maximum price of 250,000 Euros;
d) A plot could only be located where there is now a residential land use.

This resulted in zero acceptable plots in the area of interest, as can be seen in figure 22.

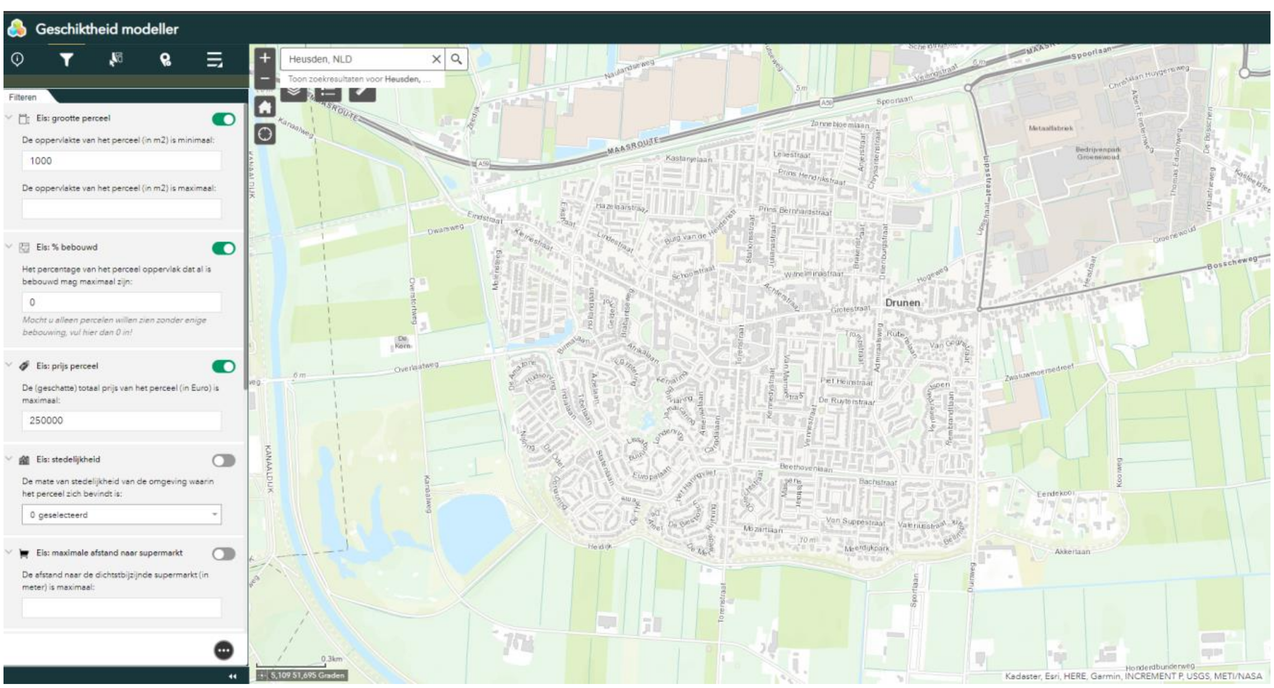

Figure 22: Output case study: no suitable plots

As no acceptable plots could be found, the respondent changed several filters. First, the maximum price was changed to 1,000,000 Euros and second, filter D (see page 102) was removed. This resulted in several acceptable plots, which can be seen in figure 23.

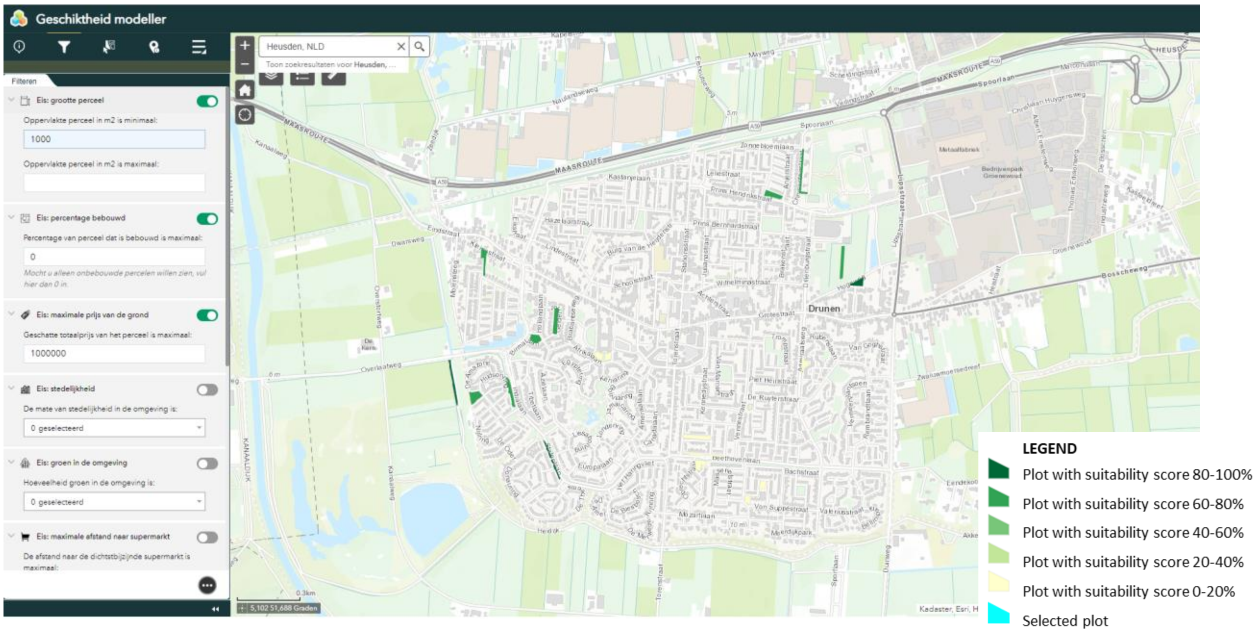

Figure 23: Output case study: found suitable plots

Two locations were used for further analysis and are highlighted in figure 24. These locations were identified as most interesting based majorly on the shape of the plot. The respondent continued working in the Excel-based assessment document.

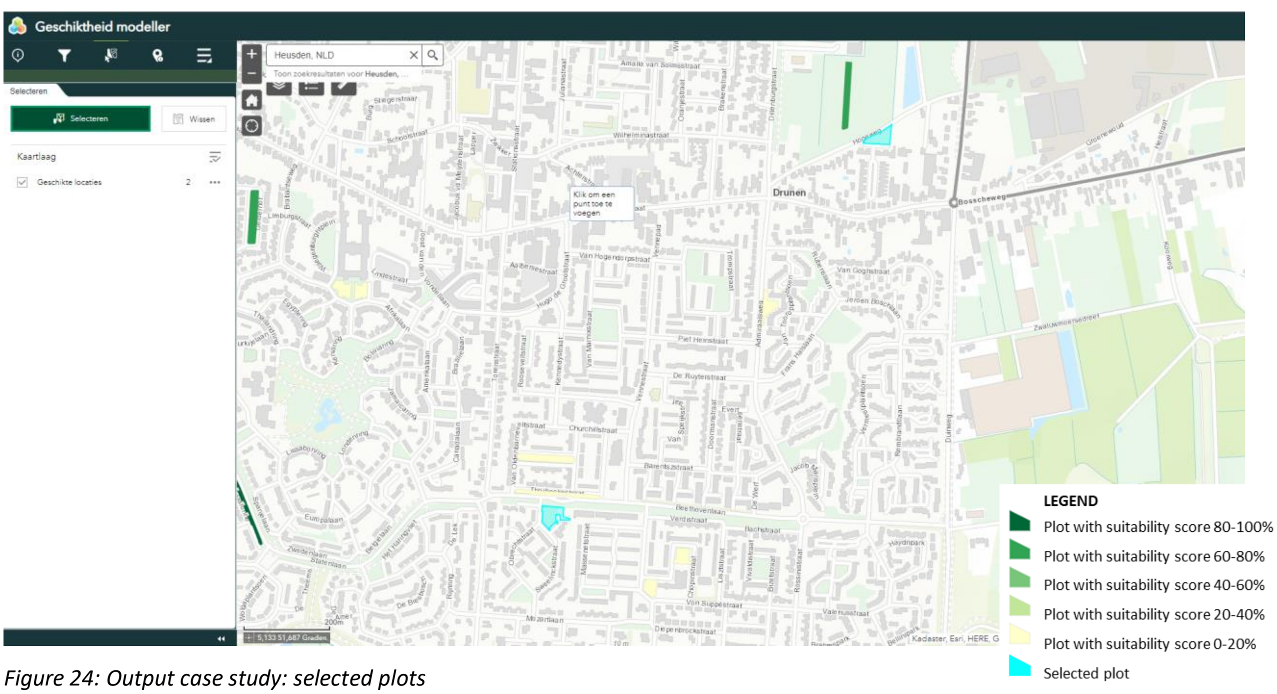

Figure 24: Output case study: selected plots

The respondent used the ‘Calculator’ worksheet to calculate the approximate area necessary for the CPC development of her CPC group. In the ‘Analysis’ worksheet, the respondent excluded the attributes ‘Distance to nearest public transport stop’ and ‘Distance to cycling network’ from the assessment. The user did not change the level of importance of the any attribute. These choices can be seen in figure 25. Furthermore, the respondent set the maximum price to 1.5 million Euros.

A. De volgende variabelen wil ik meenemen in de analyse	Meenemen?
Grootte perceel	Ja
Prijs perceel	Ja
Stedelijkheid	Ja
Groen in de omgeving	Ja
Afstand dichtstbijzijnde OV halte	Nee
Afstand dichtstbijzijnde supermarkt	Ja
Afstand tot fietsnetwerk	Nee

B. De volgende variabelen wil ik aanpassen	Mate van belang
Grootte perceel	Gebruik standaard waardes
Prijs perceel	Gebruik standaard waardes
Stedelijkheid	Gebruik standaard waardes
Groen in de omgeving	Gebruik standaard waardes
Afstand dichtstbijzijnde OV halte	Gebruik standaard waardes
Afstand dichtstbijzijnde supermarkt	Gebruik standaard waardes
Afstand tot fietsnetwerk	Gebruik standaard waardes

Mocht u een variabele niet hebben meegenomen in deel A, dan hoeft u dit niet nogmaals aan te passen in deel B. Dit wordt automatisch doorberekend.

Figure 25: Set attributes and weights case study

In the ‘Results’ worksheet, the respondent assessed the overall suitability scores of the selected plots. These suitability scores can be seen in figure 26. From these results the respondent observed that both plots scored relatively equal (around 75% of the maximum score). The difference in the percentage scores did not yield a clear favorite.

Statistieken

Hier kunt u zien hoeveel percelen in de provincie Noord-Brabant voldoen aan uw wensen. Daarnaast kunt u zien hoe goed de percelen scoren a.h.v. de (door u gekozen) toegepaste scorewaardes. U kunt deze informatie gebruiken om te zien wat voor effect een bepaalde wens heeft op het totaal aantal geschikte percelen.

Totaal aantal percelen	418034
Waarvan ongeschikt	99820
Waarvan geschikt	*318214*

Percentage ongeschikt	23.88%
Percentage geschikt	*76.12%*

% van MaxScore	Aantal	% van totaal
0-10%	79	0.0%
10-20%	1316	0.4%
20-30%	7500	2.4%
30-40%	11518	3.6%
40-50%	16092	5.1%
50-60%	23456	7.4%
60-70%	38580	12.1%
70-80%	69402	21.8%
80-90%	109505	34.4%
90-100%	40766	12.8%
Totaal	318214	100.0%

Informatie gevonden percelen

Mocht u in de *Geschiktheid modeller* meerdere percelen hebben gevonden die voldoen aan uw wensen, kunt u hieronder zien hoe goed ieder perceel scoort a.h.v. de (door u gekozen) variabelen. Dit doet u door de het perceel te selecteren in de *modeller* en de *FID* te kopiëren. Voor uw gemak kunt u de namen van de percelen wijzigen, bijvoorbeeld naar de straatnaam. Deze kunt u hieronder invullen in de geel gemarkeerde velden. Vervolgens kunt u zowel de totaalscore als individuele scores zien. Mocht de totaalscore een waarde hebben van *FALSE* , dan is het perceel ongeschikt a.h.v. de door u gemaakte keuzes. Waarom het perceel ongeschikt is, kunt u vervolgens zien aan de individuele scores. Mocht één van deze een *FALSE* score hebben, dan is deze locatie eigenschap de reden dat het perceel is afgekeurd. Mocht het zijn dat het perceel wordt afgekeurd door de score van de prijs van het perceel, is het belangrijk om te herinneren dat de percelen zijn gebaseerd op bestemmingsplannen. Wellicht als u slechts een kleiner deel van het perceel kunt bemachtigen (zie de kaartlaag "Kadastergrenzen" in de *modeller*) - kan het perceel alsnog geschikt verklaard worden.

	FID	TotaalScore	% van MaxScore	ScoreSupermarkt	ScorePrijsPerceel	ScoreOV	ScoreGroen	ScoreFiets	ScoreOppervlak	ScoreSted
Perceel 1	9189282	-0.583	74.8	-0.385	-1.484	0.000	0.078	0.000	0.355	0.468
Perceel 2	9189405	0.518	77.6	-0.385	-2.727	0.000	2.422	0.000	0.355	0.468
Perceel 3		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 4		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 5		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 6		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 7		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 8		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 10		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 11		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 12		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 13		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 14		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 15		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Min. score ->	-29.95405644	0%	-0.385	28.11	0	-2.499	0	-1.063	-2.107
	Max. score ->	9.29	100%	0.313	0.00	0	2.422	0	0.707	1.639

Figure 26: Suitability score output case study

The respondent then successfully copied the found percentage scores in the modeler with the ‘Map optimization’ function and exported it to a pdf-file. The results of optimizing the map can be seen in figure 27. Here can be seen that the selected suitable plots are visualized in green.

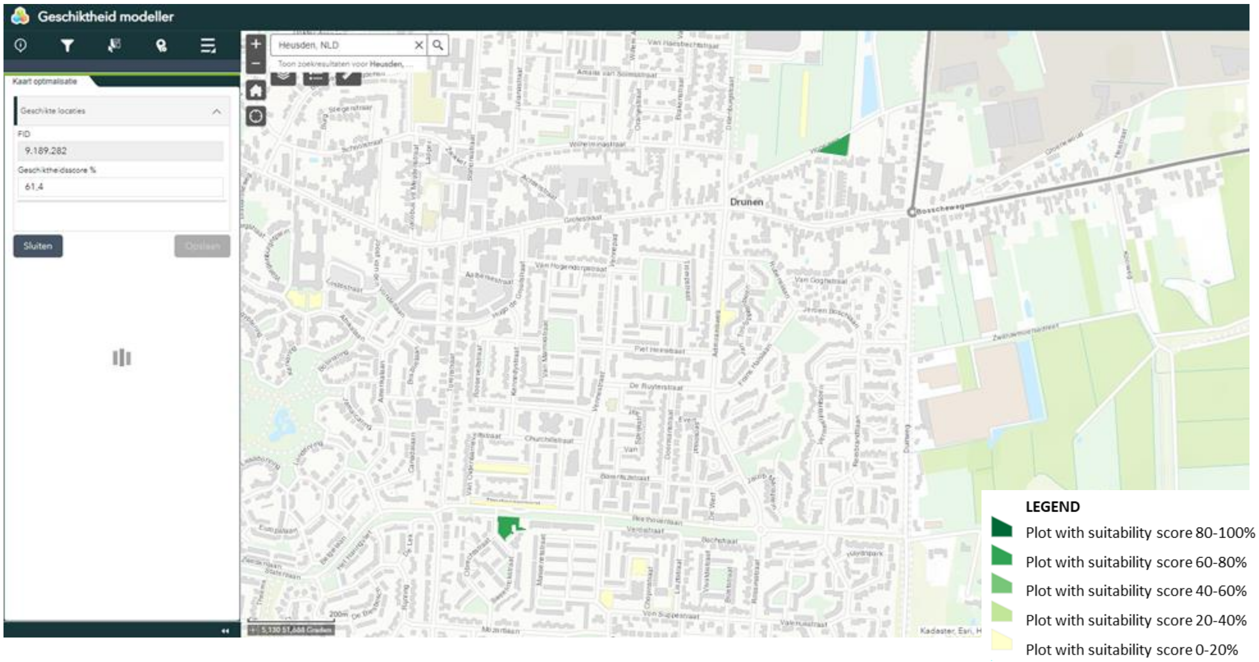

Figure 27: Map after optimization case study

8.2.2. Conclusions based on respondents' experience

The respondent concluded that there is no suitable vacant building ground present in the area of interest that has the function 'residential' in the land use plan. Therefore, it would be difficult for her CPC group to quickly realize a CPC development as first suitable plots should be converted to 'residential' in the land use plan. Only if that could be realized, a greenfield CPC residential development can take place. Another concern was that the cost of the price of the ground may be too high as well. The respondent concluded that realizing a CPC project in the desired area of interest is very difficult, if not impossible, and that the CPC group of the respondent should most likely make concessions regarding the preferences to realize the desired CPC project. Possible concessions are to consider redeveloping an existing plot, have less strict wishes regarding the size and cost of the plot or to reconsider the area of interest.

It is concluded that the developed tool works appropriately and conveniently based on the feedback from the respondent. However, the user indicated that it would be more convenient to include the functionalities of the offline (Excel) component into the online component. Still, the current functionalities are easy to understand after reading the provided information and finding a suitable location requires no intensive work as all necessary information is provided.

9. Conclusion

The goal of this thesis was to investigate the location related preferences of the CPC community and to use this information to develop a tool that guides CPC groups in finding their ideal location for development. The research question in this thesis therefore reads: how can a tool to identify the suitability level of locations for CPC developments be designed based on the preferences of the CPC community? In this final chapter the thesis concludes with a short recap on the methodology, answering the research questions, the relevance for science and society, the conclusions from this thesis and recommendations for future research and tool development.

The literature study was used to gather insights into the characteristics of CPC developments, to identify the variety of preferences of people regarding locational decision making and to assess how current studies have used similar knowledge to find suitable locations. CPC developments differ from traditional residential development since in CPC developments, the future users of the dwellings will also collectively design and build their homes, instead of only buying a dwelling after it has been built by a developer. CPC participants have more design freedom and control of the project, which often leads to more suitable, sustainable and affordable dwellings. In the literature was found that location related attributes are important factors in residential decision making. The most important location attributes were found to be related to the socio-demographic composition of an area, a clean and safe environment and accessibility to transportation, social, cultural or environmental facilities. Furthermore, in the literature study it was found that socio-demographic characteristics of people influences their location preferences. Socio-demographic characteristics found to have varying preferences are related to age, household composition, income and education level, tenure status, current urban or rural location and nationality.

Seven location related attributes are included based on the literature study: the price of the ground, the level of urbanity, the distance from the plot to a public transport stop, the distance to the supermarket, the level of greenery in the environment, the distance to the cycling network and the possibility of having communal indoor and outdoor spaces. These location related attributes were included in a stated choice experiment with the aim of acquiring data regarding the location preferences of the CPC community. The data acquired with the stated choice experiment has been analysed by a descriptive and discrete choice analysis. The results of the discrete choice analysis were used to determine the weights of the attribute levels for the suitability analysis. The descriptive and discrete choice analysis helped answering the second research question: which location related attributes and project related characteristics are considered most important by the CPC community? The discrete choice analysis consists of a multinomial logit (MNL) and latent class (LC) model. The MNL model found that inner city locations are not preferred (weight is-0.203), while suburban locations are most preferred (0.166). A distance of 400 to 800 meters to a public transport stop is also most preferred (0.186). A strong preference for the level of green in the environment can be seen back in a weight of 0.652 for highly green environments, while environments with a low level of greenery have a strong negative weight (-0.712). For the distance of the plot to the cycling network, a distance of under 600 meters is not preferred (-0.245), while greater distances are preferred. Finally, the preference of having the possibility to construct both indoor and outdoor communal spaces is strongest (0.156), followed by the possibility of having only outdoor communal spaces (0.068) In the LC analysis, four groups were found. Respondents with more CPC experience in the sample could be divided into two of these groups: CPC experienced respondents preferring inner city locations (LC group 4, weight 0.871) and respondents preferring rural locations (LC group 3, weight 1.639). Respondents with more CPC experience that prefer rural locations, also prefer locations within a ten minute walking distance to a PT stop (0.521), have the strongest preference for locations in highly green neighbourhoods (2.422) and prefer the possibility of having outdoor communal spaces (0.707). Respondents with more CPC experience that prefer inner city locations strongly prefer the possibility of having both types of communal spaces (1.345).The descriptive analysis furthermore showed people with more CPC experience have other values in residential decision making. They attach less value to the affordability of a dwelling, but attach greater value to an increased level of neighbourliness, design freedom of the dwelling and application of sustainable interventions. Furthermore, even though it was found to be less significant, people with more CPC experience tend to attach slightly less importance to a location, but attach greater value to preventing feelings of loneliness. The descriptive analysis also showed that the option to have communal indoor and outdoor space often influenced the locational decision making. Other aspects of CPC projects that influenced the locational decision making were the presence of private gardens, sustainability interventions, and the possibility to construct new-build dwellings.

A suitability analysis has been performed based on vector data. In this analysis, GIS software was used to acquire geospatial data and to conduct a general exclusion assessment. Attribute scores were based on the weights determined in the LC model, where the final suitability score was the result of the application of a weighted linear combination (WLC) approach. The result of the suitability analysis was a dataset that includes all relevant plot information, attribute values and suitability scores. This dataset is used to develop the interactive suitability assessment tool. The weights determined in the LC model, the WLC approach and the use of GIS software are also used to create the interactive suitability tool. This tool is designed specifically for the group of people currently in the initiation phase of a CPC project who are looking for a location to develop. Users of the tool are people that act out of the interest of their CPC group. The tool is designed in such a way that it allows users to apply filters, select what location related attributes will be included in their case-specific suitability analysis and alter how important they rate the included attributes. The tool consists of two components: an online component in which users can identify any suitable plots in their area of interest and an offline component in which users can assess the suitability level of the identified plots and identify the most suitable plot.

Scientific relevance

This thesis has provided more insights in the residential decision making process of people interested in CPC projects. The literature study formed the basics of a tailor-made dataset from which valuable insights were extracted regarding the socio-demographic characteristics of CPC respondents and how they value location related attributes and more. Prior this study, the literature only focused on the social benefits and qualities of CPC communities and lacked understanding the location related motives of these communities. This thesis has filled this gap in the research. This thesis differentiates itself with the approach for determining the attribute (level) weights. In this study, the weights are based on the results of a discrete choice analysis. No study was found in the literature review that uses a discrete choice analysis as well to determine the weights. In the literature, often the AHP or ANP method was used to determine the weights. One other aspect in which this study differs from existing literature is the niche suitability output for which this analysis has been conducted: CPC projects. In the literature, performing a suitability analysis for residential development was not frequently found, while an analysis for CPC development was completely absent.

Societal relevance

Considering the societal relevance, the necessity of building a tool that supports in the location identification step is supported by the descriptive analysis. Here, it was found that the majority of the respondents spend more than two years on finding a location suitable for development. Building an interactive tool that supports people with finding if a suitable location is present in their area of interest, and if so, what location they could best opt for, could help in the CPC process. This tool helps in the location identification process since it provides people interested in CPC projects with a structured approach of assessing the suitability of the location. Furthermore, this tool has collected spatial data for seven location related attributes that otherwise needs to be gathered by the users themselves. By pooling this information in one tool, users no longer need to spend more time and effort in gathering this information. If in the tool, no locations are present, CPC interests could quicker realize that they should be more flexible in their wishes or preferences, or even need to expand their area of interest. This tool does not provide answers on how easy it is to acquire the plot of land or who the current owner is. It is merely a tool usable for exploration.

Recommendations

The aim of this study was to offer people interested in CPC projects an easily accessible and transparent tool or guideline for identifying suitable locations to develop. Since this tool has been developed, it could be stated that the objective of this study has been achieved. However, recommendations could be made to increase the strength of the findings of this study and to increase the quality of the developed interactive suitability tool.

First, it is recommended to increase the number of respondents in the sample. More respondents would strengthen the findings of the analyses. For example, non-Dutch inhabitants and inhabitant of the northern provinces in The Netherlands are underrepresented in this study. Increasing the total number of respondents in the sample could strengthen the findings of this study by including these underrepresented groups.

Second, recommendations could be given regarding the suitability analysis. One recommendation is to perform the suitability analysis with a device capable of handling very large datasets and algorithms. This would allow the suitability analysis to be conducted in other provinces. This could be adopted in the tool by having an intermediate step in which users can select in which province their CPC development will take place before setting a more detailed area of interest. A more capable device can also make it possible to perform the suitability analysis on more precise plots that follow the cadastre boundaries. These boundaries could be obtained through a .wfs file, but making these boundaries workable in the analysis requires converting them into a shapefile. This would result in a very large dataset that requires a device capable of handling it. Next, in the exclusion criteria, ideally also plots in the near vicinity of busy inner city roads would be removed from consideration. However, in the found data files regarding the road infrastructure, no data could be obtained regarding the level of crowdedness on the roads. The final recommendation is that plots with an odd shape unsuitable for residential development would be excluded from consideration (e.g. plots with 200 meter in length but only 5 meters in width). An (unsuccessful) attempt was made to recognize such plots by calculating minimum or maximum dimensions of the plot. At the moment, the QGIS software does therefore not allow filtering on irregular polygon shapes.

Third, the price of the plots was determined by multiplying the area of the plot with the average price per sqm based on the distance to a city centre. However, these average prices per sqm in practice differ per municipality, meaning that not every distance (to city centre) group actually has the same land prices. The average prices per sqm were furthermore determined based on a limited number of locations. In future research, it is therefore recommended to include more locations in the analysis for determining the average land price.

Fourth, the interactive suitability tool itself could be improved. Even though it is functioning, there are still recommendations for improvement. The first recommendation is that the analysis functionalities present in the offline component of the tool should be included in the online component. If this would be realized, these offline functionalities would be more easily accessible since no (Microsoft Excel) software licenses are needed by the users. Also, it would be easier to work with the data and create maps in which the case-specific suitability scores are visualized. The reason why these functionalities are not already present in one online component is due to the lack of advanced coding skills of the developer and due to the lacking ArcGIS WebApp Builder software, in which these functionalities are not already added as widgets. As these functionalities are now included in the Excel software, tasks that would normally be done by the software itself, should now be performed by the user. This requires that additional information should be present in the Excel assessment document explaining what the users need to do. Working with Excel and having so much explanatory information could make the tool too difficult to work with for some users. Therefore, users are recommended to first try to work with the tool themselves and if they face any (user-friendliness or software) problems, use the tool together with their CPC advisory company. Another recommendation is that the tool could be expanded so more attributes could be included in the tool. In the current version of the tool, only attributes and weights are included that were based on the LC model. However, since the group of people interested in CPC developments is so diverse, it could be that users would like to include more and other location attributes, such as e.g. distance to schools or sport facilities. Adding more attributes should be done with caution, since in the tool only attributes are included that are proven to have an influence on locational decision making. Finally, it is advised that the current version of the tool should only be used in the coming years. In the future, location related attributes of plots can change as e.g. more supermarkets can be build. Therefore, it is advised that every five years, the spatial data should be updated.

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Appendices

Appendix A: Literature methodology overview

In this appendix, the literature methodology overviews can be seen for each of the individual research questions. First, the overview is given for the importance of location in residential preferences.

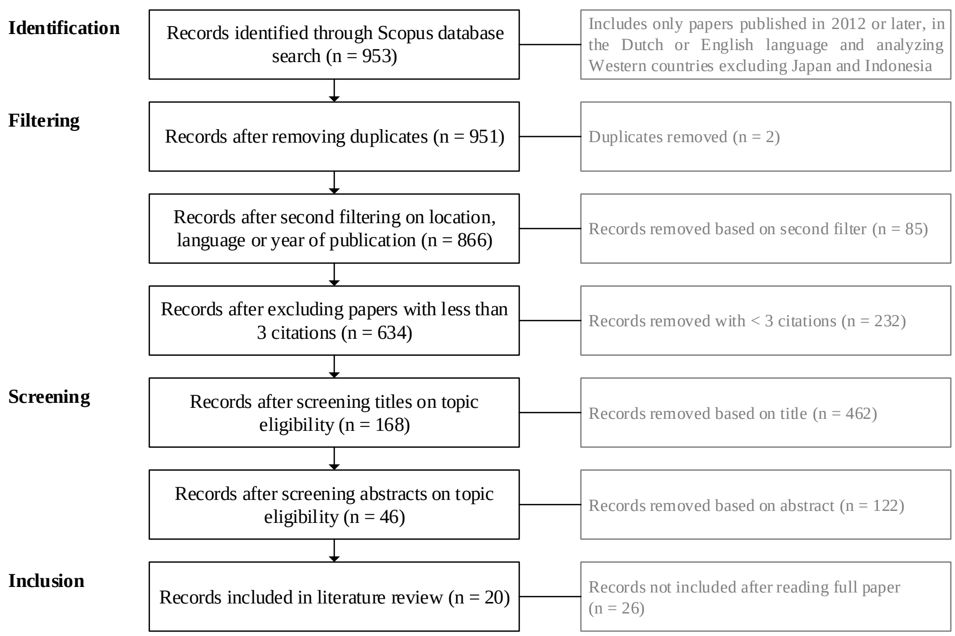


Figure 28: Literature methodology 'Importance location'

Second, the overview is given for the differences based on socio-demographics regarding residential preferences.

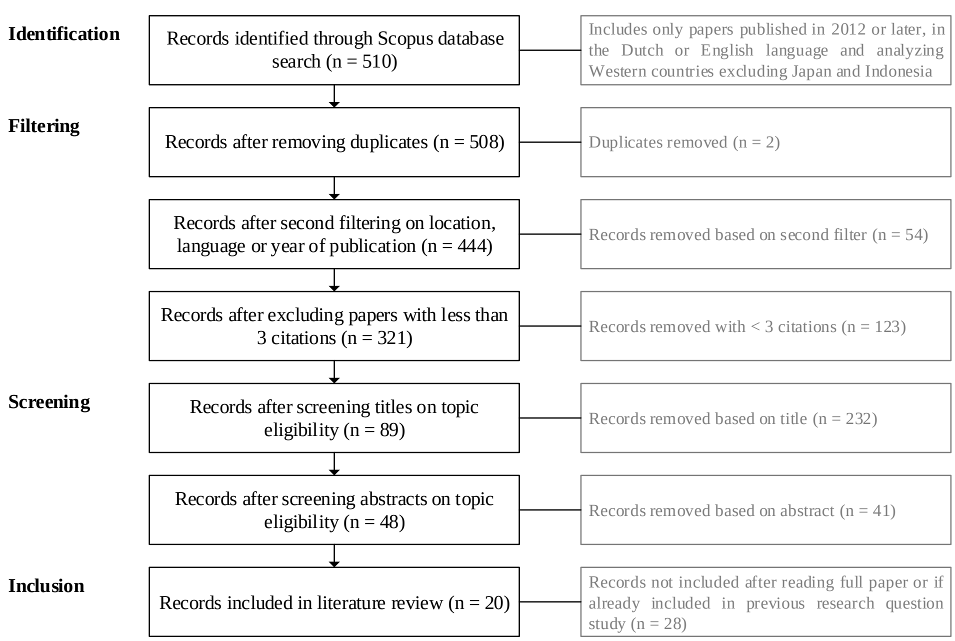


Figure 29: Literature methodology 'Socio-demographics'

Third, the overview is given for literature assessing various components of collective private commissioning.

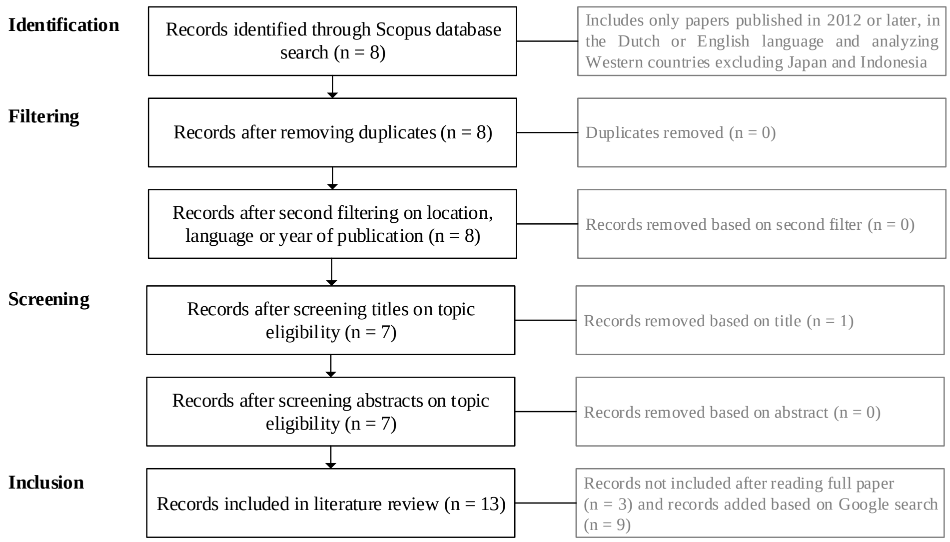


Figure 30: Literature methodology 'CPC'

Fourth, a first literature overview is given for the residential preference differences for people favouring redevelopment or new-build.

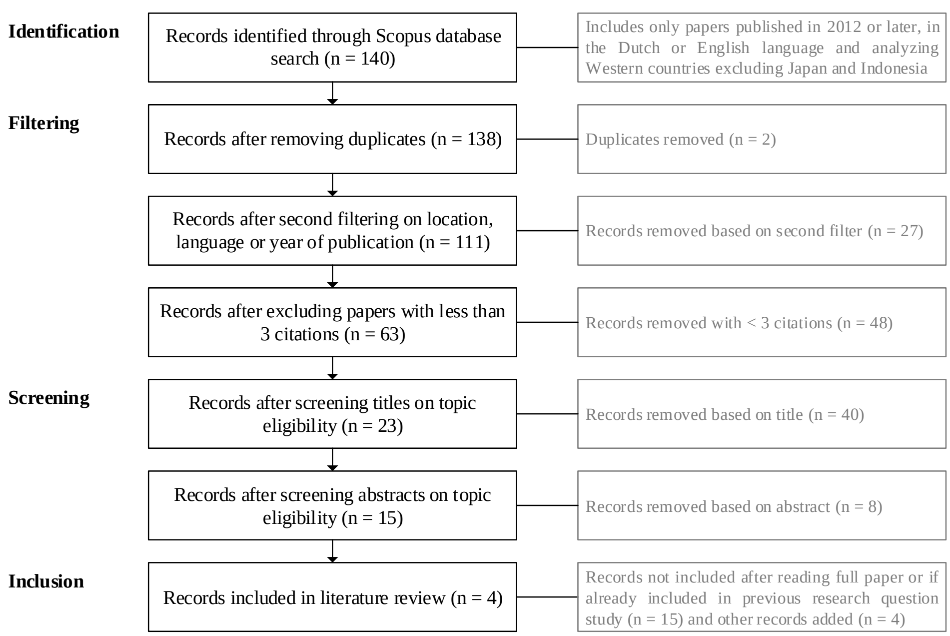


Figure 31: Literature methodology 'Development type'

Fifth, the overview is given for the residential preference differences of people favouring living in either rural or urban environments.

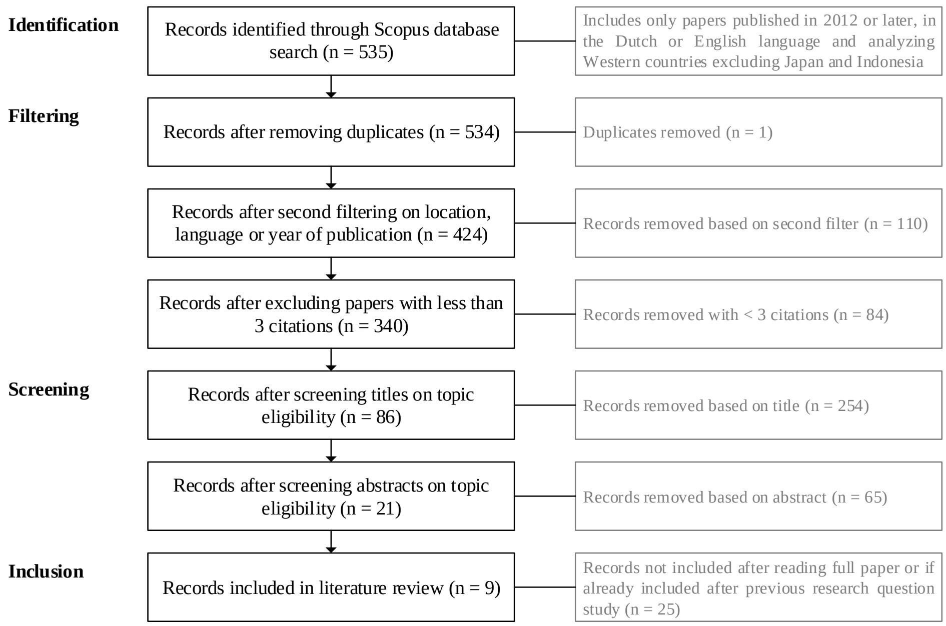


Figure 32: Literature methodology 'Urban and rural'

Sixth and finally, the overview is given for the approach of existing studies to identify suitable locations.

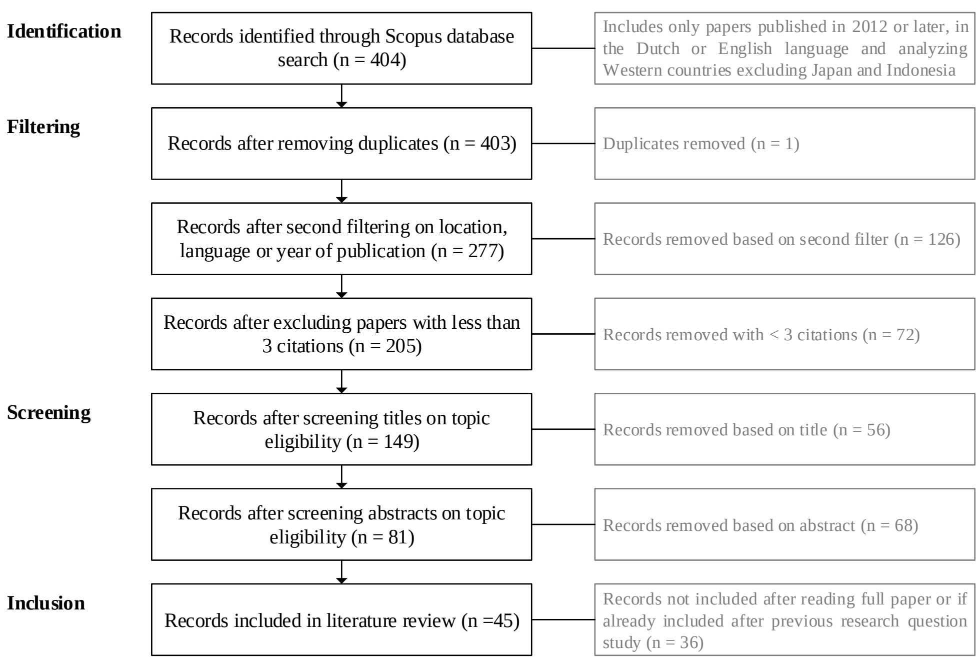


Figure 33: Literature methodology 'Existing suitable location identification'

Appendix B: Overview location attributes

In this appendix, all found location attributes found relevant in the literature study can be found in table 26. Here can be seen how often the location attributes were found significantly influencing the residential decision making.

Table 26: Literature overview location attributes

#	Attribute	Literature count	Unit
1	Compact location or density	18	Population / km2
2	Proximity to natural facilities (green, water)	15	Meter
3	Safety or security	11	Crime rate
4	Proximity to public transport facilities	11	Meter
5	Proximity to education facilities	11	Meter
6	Proximity to employment facilities	8	Meter
7	Proximity to grocery store	8	Meter
8	(Proximity to) Central location	7	Meter
9	Proximity to shops	6	Meter
10	Pedestrian facilities or walkability	5	Area / km2
11	Socio-demographic composition	4	%
12	Proximity to health or care facilities	4	Meter
13	Proximity to recreational facilities	4	Meter
14	Cleanliness	2	
15	Cycling facilities or network	2	Cycling area / km2
16	Parking facilities	2	Parking area / km2
17	Density of cultural facilities*	2	Facilities / km2
18	Density of commercial facilities*	1	Facilities / km2
19	Density of social facilities*	1	Facilities /km2
20	Environmental conditions (noise, air quality)	1	
21	Proximity to religious facilities	1	Meter

Often in the studies, the generic word ‘facilities’ was used, which did not differentiate between cultural, commercial or social facilities / facilities. These studies are not therefore not added to the literature count.

Appendix C: Overview (deleted) land uses

In this appendix an overview can be found for all land uses present in the original vector layer of landuse plots. All land uses are listed in table 27. In this table, all land uses (in Dutch) where the cells are highlighted in orange are deleted from the vector layer. If the landuse has a * behind it, it means that there was a variety of land uses that can be categorized into that group. The number of land uses is indicated between brackets.

Table 27: Overview all land uses in original vector layer

Attribute
Aardkundig en gemorfologisch waardevolle gebieden
Afwijken bouwregels bebouwd gebied
Afwijken bouwregels open gebied
Agrarisch bedrijf* (27)
Agrarisch gebied
Agrarisch overig* (26)
Agrarisch - Wonen in het groen
Agrarisch bouwblok (met toegesneden bestemming of glastuinbouw)
Agrarisch gebied met waarden* (142)
Agrarisch randgebied
Agrarische (bedrijfs)doeleinden
Algemene regels
Bebouwd gebied
Bedrijf*
Bedrijf - Agrarisch (verwant)
Bedrijf - Algemeen Nut
Bedrijfsdoeleinden*
Bedrijventerrein
Beekdal* (3)
Begraafplaats
Beperkingengebied veehouderij
Bijgebouwen bij wonen
Bomen en houtopstanden
Bos(gebied)
Bosrijke ontginningen met buurtschappen
Bouwen (bedrijfsgerelateerd)
Bouwen (woninggerelateerd)
Buisleidingenstraat of -strook
Buitenplaats
Caravanstalling
Centrum(doeleinden of -gebied)
Cultuur en ontspanning* (20)
Dagrecreatieve doeleinden
Detailhandel* (26)
Dienstverlening
Dierenkliniek

Doelmatig hergebruik voormalige kloostercomplexen
Dorpslandschap
Dorpsvoorzieningen
Ecologische verbindingszone
Enken
Erf
Evenementen
Extensief Recreatiegebied
Fort
Functieverandering* (9)
Garagebedrijf of -boxen
Gasdrukmeet- en regelstation
Gebruik - voorwaardelijke bepaling
Gemeentelijke monumenten
Gemengd* (78)
Gezondheidszorg
Groen*
Groen - Afschermend groen
Groen - Berm
Groen - Bomensingels
Groen - Groen en water
Groen - Hoofdgroenstructuur
Groen - Landelijk groen
Groen - Landschap
Groen - Landschapselelement
Groen - Landschapspark
Groen - Natuur
Groen - Openbaar
Groen - Park
Groen - Water(berging)
Groenblauwe mantel
Groenvoorzieningen*
Herziening* (18)
Honden- en paardensport
Horeca(doeleinden)*
Hoveniersbedrijf
Incindenteel parkeren
Innovatieregeling
Intensief Recreatiegebied
Kades* (4)
Kampenlandschap met enken
Kantoor*
Karakteristieke gebouwen
Landgoed
Maatschappelijk* (60)
Manege

Militair (gebied) met landschappelijke waarden en natuurwaarden
Molen
Multifunctioneel centrum
Nadere regels voor alle archeologische waarden
Natuur* (24)
Nutsdoeleinden of -voorzieningen
Onbebouwd gebied
Ontspanning en vermaak
Onverharde wegen
Open gebied
Overgang beekdal
Overig*
Paintball-baan
Parkeren
Peelontginningenlandschap
Primaire waterkering
Productielandschap
Recreatie* (113)
Rioolwaterzuiveringsinstalatie
Schietbaan
Specifieke regels voor paarden- of veehouderij
Spoorwegdoeleinden
Sport* (38)
Tuin* (39)
Vaarwater
Verblijfsrecreatieve doeleinden
Verboden gebruik* (9)
Verkeer* (94)
Verklarende regels
Vogelbeheergebied
Waarde archeologie of cultuurhistorie* (5)
Water* (45)
Welstandsregels
Wonen* (182)
Woondoeleinden* (8)
Woongebied* (38)
Woonwagencentrum of -doeleinden
Woonwerklandschap met buurtschappen
Zandwinning
Zone hippische bedrijven

Appendix D: Exclude plots with buildings on them

It might be that in a suitability assessment, only plots without any buildings on them should be considered. Therefore, this is a case-specific exclusion criteria. Irrelevant whether this exclusion criteria is included, the percentage of the plot that is built upon should be calculated for all plot assessments. Adding this as an attribute to the attribute table can be done by using the 'Overlap analysis' function in QGIS. This will result in an added attribute that calculates the total area (in sqm) on the plot that is built upon and the percentage of the plot that is built upon.

Adding the exclusion criteria to the output can be done in several ways. The easiest (and quickest) way is to add an extra condition to the existing suitability score formula. The condition that is added is indicated in black in the formula below and says if the plot has been built upon for more than 0% of the total area, then it suitability score will be NULL and thus be excluded from the suitability assessment.

```
CASE
WHEN  "UtilityPT" = -9999 OR  "UtilityPri" = NULL OR  "UtilitySup" = -9999 OR  "UtilityCyc" = -9999 OR
"UtilityAre" = -9999 OR  "UtilityUrb" = -9999 OR “%built’ > 0 THEN NULL
ELSE  "UtilitySup" + "UtilityPri" + "UtilityPT" + "UtilityGro" + "UtilityCyc" + "UtilityAre" + "UtilityUrb"
END
```

Appendix E: Cost per sqm of land analysis

In this appendix the basic analysis to determine the used price per sqm of land can be found. The final results are used to determine the cost of land for all the plots. These prices are categorized per distance to closest city centre. In the analysis only municipalities are used that are located in the province Noord-Brabant. The overview of the analysis can be found in table 28 and 29. In the overview, all prices are including taxes (21%). Thus, if a land price was given without taxes, this number was multiplied by 1.21. The distances are calculated from centroid of the municipality or town/city to the centroid of the city centre.

Table 28: Detailed analysis land cost

Municipality or town	Name	Distance to city centre (km)	Price per sqm (free sector or project based)			Source
			Minimum	Maximum	Mean	
Municipality	Eindhoven	0 to 5	-	-	-	Municipality Eindhoven (2021)
Municipality	Tilburg	0 to 5	>205	>205	-	Municipality Tilburg (2023)
Municipality	Helmond	0 to 5	387	430	408	Overheid.nl (2020)
City	Bergen op Zoom	0 to 5	454	508	475	Overheid.nl (2022)
Municipality	Oss	0 to 5	448	448	-	Municipality Oss (2022)
Town	Halsteren	0 to 5	430	484	451	Overheid.nl (2022)
Municipality	Veldhoven	5 to 10	482	748	626	Municipality Veldhoven (2023)
Municipality	Best	5 to 10	490	490	-	Municipality Best (2021)
Town	Nuenen	5 to 10	375	375	-	Municipality Nuenen (2023)
Municipality	Geldrop	5 to 10	-	-	-	Municipality Geldrop-Mierlo (2023)
Municipality	Deurne	5 to 10	-	-	-	Municipality Deurne (2023)
Municipality	Heusden	5 to 10	-	385	-	Overheid.nl (2021)
Town	Lepelstraat	5 to 10	409	460	428	Overheid.nl (2022)
Town	Haaren / Helvoirt	5 to 10	333	454	385	Overheid.nl (2018)
Town	Esch	5 to 10	333	430	373	Overheid.nl (2018)
Town	Biezenmortel	5 to 10	333	405	-	Overheid.nl (2018)
Town	Uden	10 to 15	430	514	454	Overheid.nl (2023)

Town	Schijndel	10 to 15	436	629	500	Municipality Meierijstad (2023)
Town	Steenbergen	10 to 15	-	303	-	Overheid.nl (2020b)
Town	Reek	10 to 15	312	375	346	Overheid.nl (2023)
Municipality	Alphen	10 to 15	346	408	396	Municipality Alphen Chaam (2023)
Municipality	Bergeijk	15 to 20	293	350	-	Municipality Bergeijk (2023)
Town	Volkel	15 to 20	345	428	390	Overheid.nl (2023)
Town	Odiliapeel	15 to 20	312	375	345	Overheid.nl (2023)
Town	Reusel	more than 20	300	-	-	Overheid.nl (2021b)
Town	Hooge Mierde	more than 20	280	-	-	Overheid.nl (2021b)

Table 29: Mean price per sqm

Distance to centre	Mean price per sqm
0 to 5 km	447
5 to 10 km	430
10 to 15 km	400
15 to 20 km	327
>20 km	290

Appendix F: Results individual vector layers

In this appendix, the results of the data collection and data manipulation can be found for every individual vector layer. For the price layer, no figure is presented since the price per sqm is solely based on the level of urbanity.

Level of urbanity

The level of urbanity map that has been created in QGIS on the district (Dutch: wijk) level. The result can be seen in figure 34.

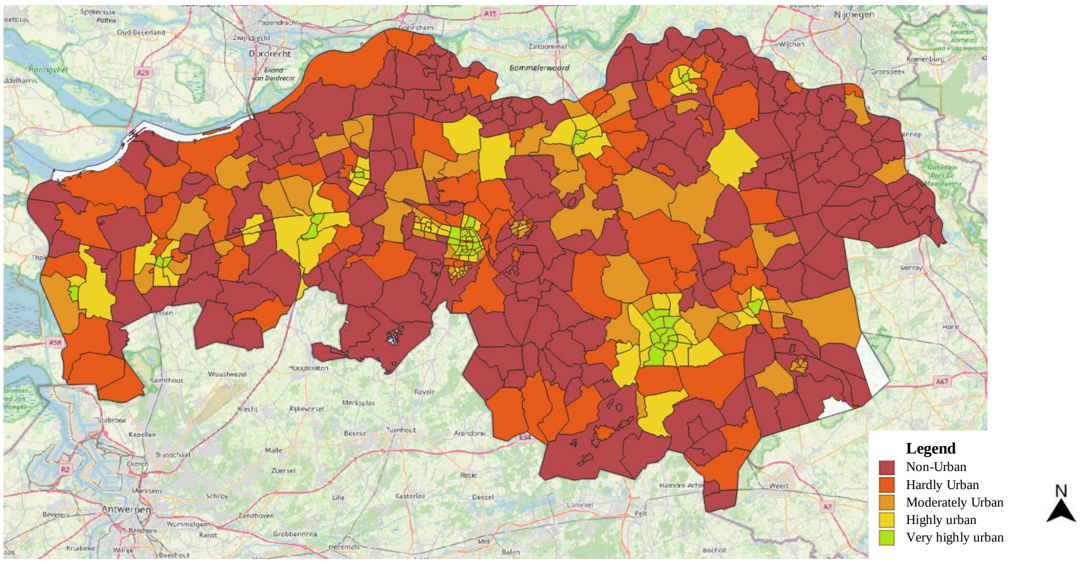


Figure 34: Map urbanity-levels

Public transport stop

All public transport stops in- and surrounding the province Noord-Brabant can be seen in figure 35. In this figure, every point represents either a bus stop or train station.

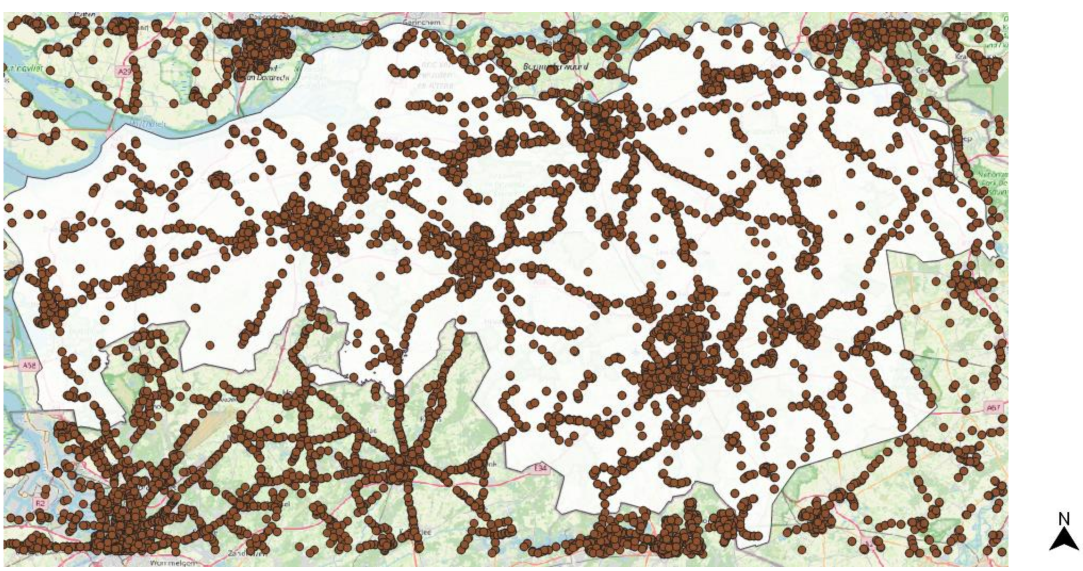


Figure 35: Map public transport stops

Supermarket

All supermarkets in the province Noord-Brabant can be seen in figure 35. In this figure, every supermarket is represented with a yellow point.

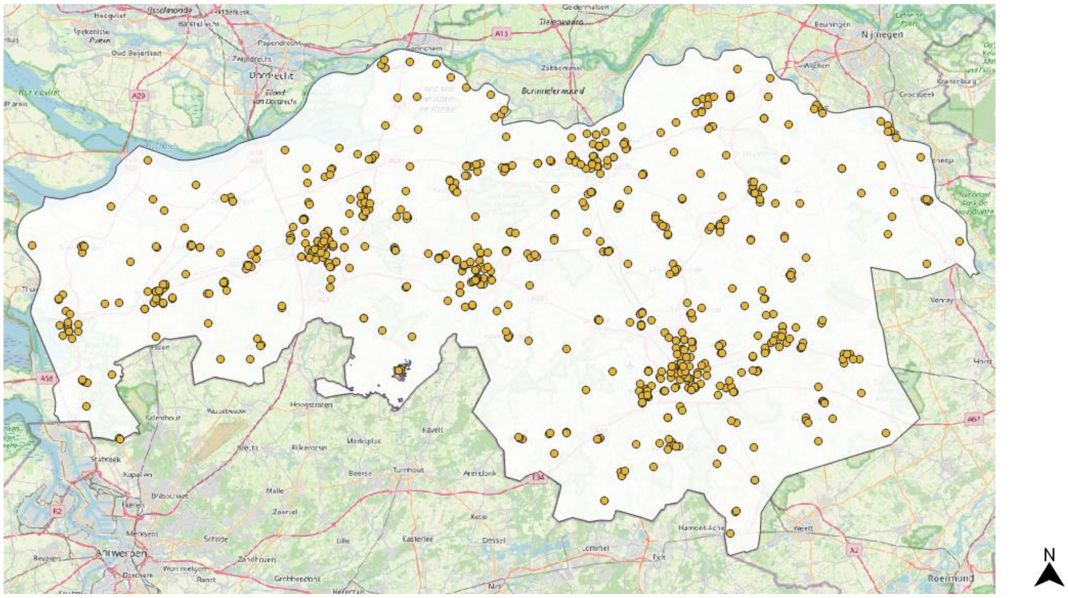


Figure 36: Map supermarkets

Level of greenery

The level of greenery map that has been created in the QGIS software can be seen in figure 37. The level of greenery has been determined on district (Dutch: wijk) level.

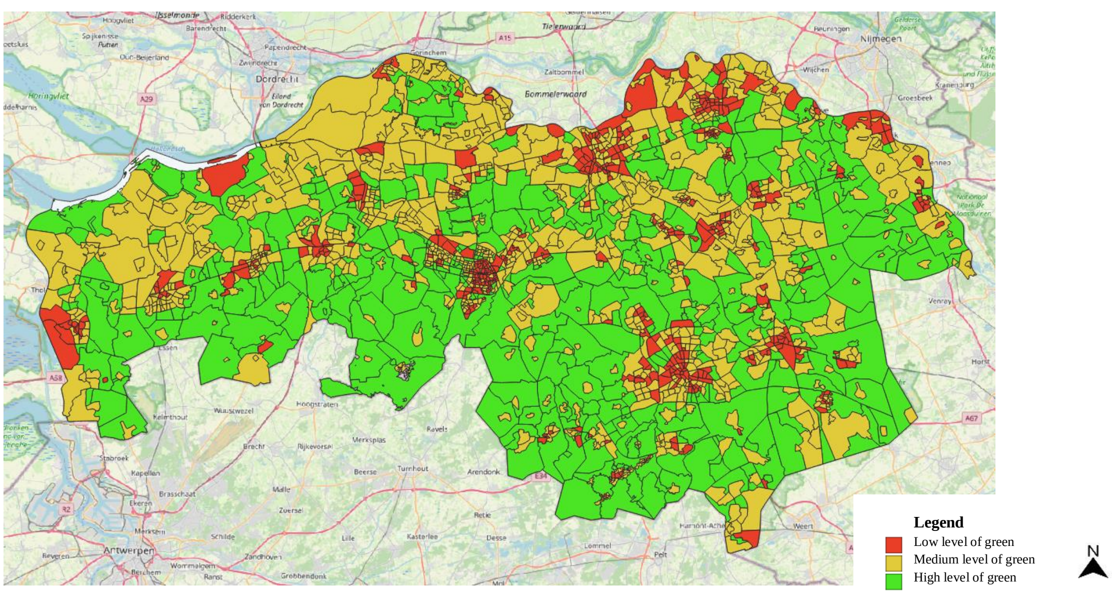


Figure 37: Map greenery levels

Cycling network

All (main) cycling lanes in- and surrounding the province Noord-Brabant can be seen in figure 38. In this figure, every black line represents a fragment of the main cycling network.

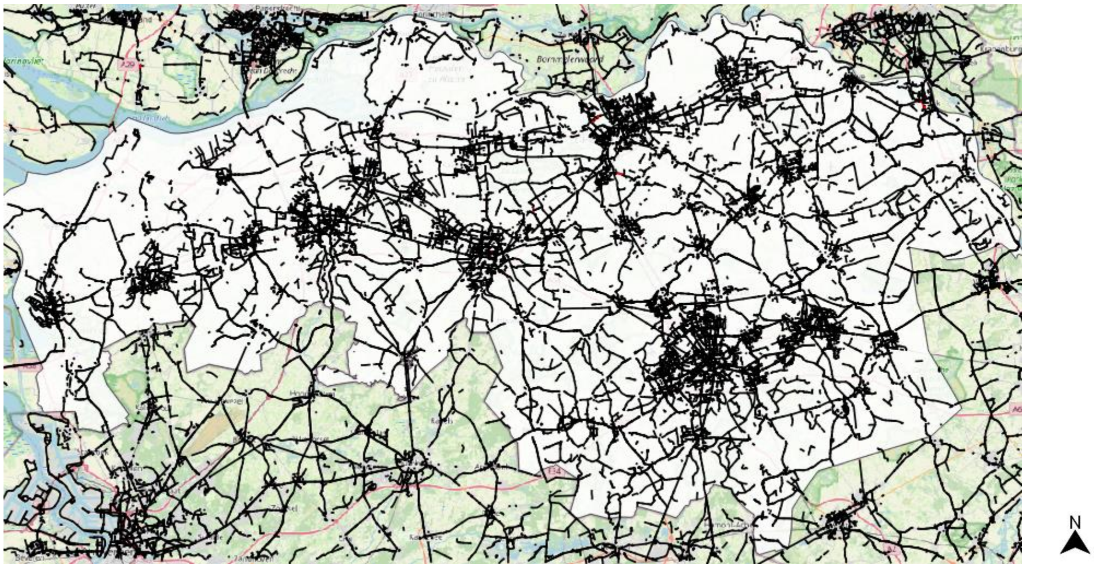


Figure 38: Map cycling network

Plots for development

All plots on which (future) development might be possible, after applying the exclusion criteria, can be seen in figure 39. In this figure, every pink polygon represents a plot for development.

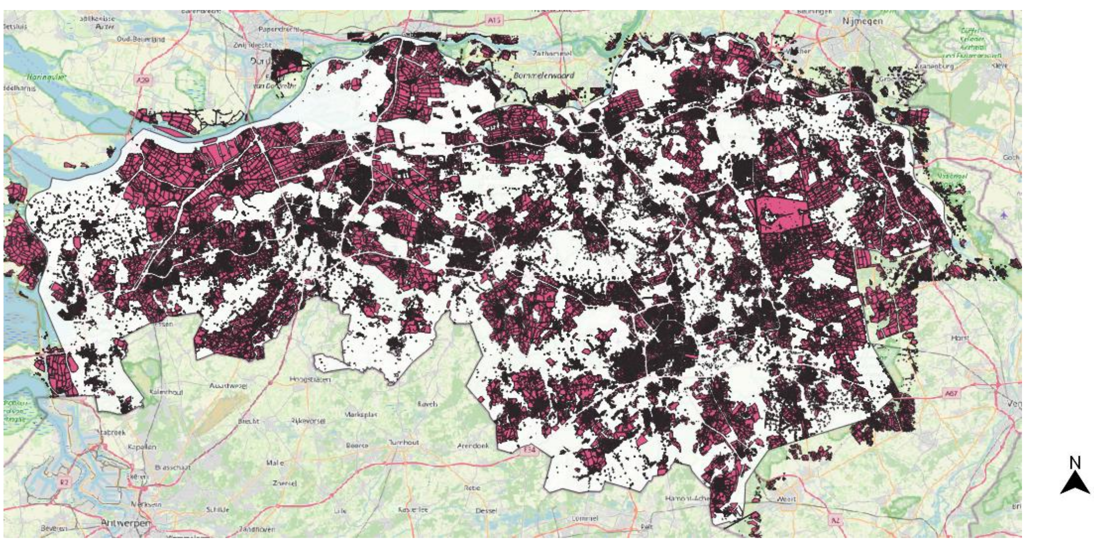


Figure 39: Map all considerable plots for development

Appendix G: Overview possible attributes in SCE

In this appendix, all attributes that could be used in the stated choice experiment can be seen in table 30-32. All these attributes stem from the literature. The attribute levels are not finite.

Table 30: Overview all possible background attributes

#	Group	Attribute	Levels
1	Background	Age	(1) Ages 0-24 (2) Ages 25-34 (3) Ages 35-44 (4) Ages 45-54 (5) Ages 55-64 (6) Ages 65-74 (7) Ages 75 and more
2	Background	Household size	(1) Household of 1 person (2) Household of 2 people (3) Household of 3 people (4) Household of more than 3 people
3	Background	Household composition	(1) Single (unmarried, no couple or divorced) (2) Single (widow) (3) Couple without children (4) Couple with children (living at home) (5) Couple with nest leavers (children no longer living at home)
4	Background	Education level	(1) Low (2) Middle (3) High
5	Background	Income level	(1) Low (2) Middle (3) High
6	Background	Tenure status	(1) Owner-occupied (2) Rental
7	Background	Nationality / ethnicity	(1) Native Dutch (2) Western immigrants (3) Non-Western immigrants
8	Background	Gender	(1) Male (2) Female (3) Other identification
9	Background	Relation with CPC	(1) Never heard of CPC (2) Not interested in CPC (3) Interested in CPC (4) Currently in CPC initiation phase (5) Currently in CPC development phase (6) Living in CPC constructed dwelling

10	Background	Importance location in home decision	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important
11	Background	Motive for CPC: Affordability	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important
12	Background	Motive for CPC: Sustainable living	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important
13	Background	Motive for CPC: Independent living	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important
14	Background	Motive for CPC: Social relations	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important
15	Background	Motive for CPC: Design freedom and control	(1) Not important (2) Little important (3) Medium important (4) Somewhat important (5) Very important

Table 31: Overview all possible context attributes

#	Group	Attribute	Levels
16	Context	Size of project	(1) Small (#dwellings 2-9) (2) Medium (#dwellings 10-24) (3) Large (#dwellings 25 and more)
17	Context	Target group	(1) Heterogeneous (variety) (2) Homogeneous (starters) (3) Homogeneous (mediors) (4) Homogeneous (seniors) (5) Homogeneous (other)
18	Context	Type of CPC * (collective facilities)	(1) With collective indoor facilities (1) With collective outdoor facilities (1) With both collective facilities (2) Without collective facilities
19	Context	Type of CPC (sustainability)	(1) Sustainable intentions (2) No sustainable intentions
20	Context	Urbanity	(1) Rural (2) Suburban (3) Urban
21	Context	Transformation or not	(1) Transformation of existing building(s) (2) Newly constructed building(s) (3) Combination transformation and new

*This attribute can also be used as a differentiating attribute. Then it could be that the possibility to build the collective facilities are the choice options.

Table 32: Overview all possible location attributes

#	Group	Attribute	Levels	Unit
22	Attribute	Price of the ground	(1) Low) (2) Medium (3) High	Euro
23	Attribute	Density or compactness	(1) Low (2) Medium (3) High	Pop. / km2
24	Attribute	Safety or security	(1) Very safe (2) Safe (3) Unsafe	Crime rate
25	Attribute	Proximity to natural facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
26	Attribute	Proximity to public transport	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
27	Attribute	Proximity to education facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter

28	Attribute	Proximity to employment facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
29	Attribute	Proximity to grocery store	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
30	Attribute	Proximity to central location	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
31	Attribute	Proximity to shops	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
32	Attribute	Proximity to health- or care facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
33	Attribute	Proximity to recreational facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
34	Attribute	Proximity to religious facilities	(1) Within walking distance (5 min) (2) Within cycling distance (5 min) (3) Within driving distance	Meter
35	Attribute	Socio-demographic composition area	(1) High homogeneity (> 80%) (2) Medium homogeneity (40-80%) (3) Low homogeneity (< 40%)	Share of population
36	Attribute	Cleanliness	(1) Very clean (2) Clean (3) Not clean	
37	Attribute	Cycling facilities	(1) High density of cycling network (2) Medium density (3) Low density	Road km / km2
38	Attribute	Walking facilities	(1) High density of pedestrian network (2) Medium density (3) Low density	Road km / km2
39	Attribute	Parking facilities	(1) High density of parking facilities (2) Medium density (3) Low density	Parking spots / km2
40	Attribute	Air quality	(1) Excellent air quality (2) Good air quality (3) Poor air quality	
41	Attribute	Noise nuisance	(1) No noise nuisance (2) Some noise nuisance (3) Much noise nuisance	
42	Attribute	Density natural facilities	(1) High density (2) Medium density (3) Low density	Km2 / km2

43	Attribute	Density public transport	(1) High density (2) Medium density (3) Low density	Number / km2
44	Attribute	Density education facilities	(1) High density (2) Medium density (3) Low density	Number / km2
45	Attribute	Density employment facilities	(1) High density (2) Medium density (3) Low density	Number / km2
46	Attribute	Density grocery stores	(1) High density (2) Medium density (3) Low density	Number / km2
47	Attribute	Density shops	(1) High density (2) Medium density (3) Low density	Number / km2
48	Attribute	Density health- or care facilities	(1) High density (2) Medium density (3) Low density	Number / km2
49	Attribute	Density recreational facilities	(1) High density (2) Medium density (3) Low density	Number / km2
50	Attribute	Density religious facilities	(1) High density (2) Medium density (3) Low density	Number / km2

Appendix H: Choice tasks

The respondents were given 9 choice tasks in which they had to select their preferred alternative for a location. In total, 27 choice alternatives were created which varied on at least one of the seven included attributes. An overview of all these choice alternatives can be seen in figure 40 (in Dutch). These alternatives are presented in Dutch, since these were also presented to the respondents in Dutch. These 27 choice alternatives were then doubled and randomized, by which the choice tasks were made. The overview of these choice tasks and to which groups (A, B or C) they belonged, can be seen in table 33.

Table 33: Overview choice task groups

Group	Choice task	Option A	Option B
A	1	14	9
	2	13	18
	3	26	20
	4	23	3
	5	17	27
	6	19	5
	7	12	26
	8	10	17
	9	20	16
B	10	1	19
	11	2	13
	12	25	8
	13	3	12
	14	15	25
	15	11	6
	16	8	14
	17	21	11
	18	4	1
C	19	27	15
	20	24	23
	21	5	10
	22	9	7
	23	16	24
	24	6	2
	25	18	22
	26	7	21
	27	22	4

#	Prijs grond	Stedelijkheid	Afstand tot OV	Afstand tot supermarkt	Groen in de omgeving	Fietsnetwerk	Gezamenlijke ruimtes
1	360 000 Euro	(Binnen)stad	Tot 5 minuten lopen	Tot 5 minuten lopen	Weinig groen in de omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
2	360 000 Euro	(Binnen)stad	Tot 10 minuten lopen	Tot 5 minuten fietsen	Erg groene omgeving	Goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
3	360 000 Euro	(Binnen)stad	Tot 15 minuten lopen	Meer dan 5 minuten fietsen	Enigzins groene omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
4	360 000 Euro	Aan de rand van de stad	Tot 5 minuten lopen	Tot 5 minuten fietsen	Enigzins groene omgeving	Matige verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
5	360 000 Euro	Aan de rand van de stad	Tot 10 minuten lopen	Meer dan 5 minuten fietsen	Weinig groen in de omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
6	360 000 Euro	Aan de rand van de stad	Tot 15 minuten lopen	Tot 5 minuten lopen	Erg groene omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
7	360 000 Euro	Dorp of platteland	Tot 5 minuten lopen	Meer dan 5 minuten fietsen	Erg groene omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
8	360 000 Euro	Dorp of platteland	Tot 10 minuten lopen	Tot 5 minuten lopen	Enigzins groene omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
9	360 000 Euro	Dorp of platteland	Tot 15 minuten lopen	Tot 5 minuten fietsen	Weinig groen in de omgeving	Erg goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
10	400 000 Euro	(Binnen)stad	Tot 5 minuten lopen	Tot 5 minuten fietsen	Enigzins groene omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
11	400 000 Euro	(Binnen)stad	Tot 10 minuten lopen	Meer dan 5 minuten fietsen	Weinig groen in de omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
12	400 000 Euro	(Binnen)stad	Tot 15 minuten lopen	Tot 5 minuten lopen	Erg groene omgeving	Erg goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
13	400 000 Euro	Aan de rand van de stad	Tot 5 minuten lopen	Meer dan 5 minuten fietsen	Erg groene omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
14	400 000 Euro	Aan de rand van de stad	Tot 10 minuten lopen	Tot 5 minuten lopen	Enigzins groene omgeving	Goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
15	400 000 Euro	Aan de rand van de stad	Tot 15 minuten lopen	Tot 5 minuten fietsen	Weinig groen in de omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
16	400 000 Euro	Dorp of platteland	Tot 5 minuten lopen	Tot 5 minuten lopen	Weinig groen in de omgeving	Matige verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
17	400 000 Euro	Dorp of platteland	Tot 10 minuten lopen	Tot 5 minuten fietsen	Erg groene omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
18	400 000 Euro	Dorp of platteland	Tot 15 minuten lopen	Meer dan 5 minuten fietsen	Enigzins groene omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
19	440 000 Euro	(Binnen)stad	Tot 5 minuten lopen	Meer dan 5 minuten fietsen	Erg groene omgeving	Matige verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
20	440 000 Euro	(Binnen)stad	Tot 10 minuten lopen	Tot 5 minuten lopen	Enigzins groene omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
21	440 000 Euro	(Binnen)stad	Tot 15 minuten lopen	Tot 5 minuten fietsen	Weinig groen in de omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
22	440 000 Euro	Aan de rand van de stad	Tot 5 minuten lopen	Tot 5 minuten lopen	Weinig groen in de omgeving	Goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes
23	440 000 Euro	Aan de rand van de stad	Tot 10 minuten lopen	Tot 5 minuten fietsen	Erg groene omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
24	440 000 Euro	Aan de rand van de stad	Tot 15 minuten lopen	Meer dan 5 minuten fietsen	Enigzins groene omgeving	Erg goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
25	440 000 Euro	Dorp of platteland	Tot 5 minuten lopen	Tot 5 minuten fietsen	Enigzins groene omgeving	Erg goede verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke binnenruimtes
26	440 000 Euro	Dorp of platteland	Tot 10 minuten lopen	Meer dan 5 minuten fietsen	Weinig groen in de omgeving	Goede verbinding met fietsnetwerk	Mogelijkheid tot zowel gezamenlijke binnen- als buitenruimtes
27	440 000 Euro	Dorp of platteland	Tot 15 minuten lopen	Tot 5 minuten lopen	Erg groene omgeving	Matige verbinding met fietsnetwerk	Alleen mogelijkheid tot gezamenlijke buitenruimtes

Figure 40: All profiles

Appendix I: Full survey

In this appendix the entire survey will be presented. This survey was distributed in Dutch and therefore, also here the survey will be in Dutch. The different pages can be identified by the button "*Volgende*", which can be seen in the green box on the bottom right.

Onderzoek naar woonwensen en motieven

Beste respondent,

Welkom bij deze vragenlijst voor mijn afstudeeronderzoek. Dit onderzoek voer ik uit voor mijn master aan de Technische Universiteit in Eindhoven. Mijn onderzoek gaat over de verschillende woonvoorkeuren en –motieven, waarbij vooral wordt gekeken naar de locatie van een woning.

Het invullen van de vragenlijst is vrijwillig. In deze vragenlijst wordt u gevraagd om een keuze te maken tussen twee mogelijke locaties om te gaan wonen. Het invullen van de vragenlijst duurt ongeveer 10 minuten. Uw antwoorden worden anoniem opgeslagen en verwerkt. Bij deze wil ik u alvast van harte bedanken voor het invullen van de vragenlijst. Mocht u nog vragen hebben dan kunt u contact opnemen met mij via: j.w.m.poel@student.tue.nl.

Met vriendelijke groet,

Jasper Poel
Master student TU/Eindhoven

Volgende

Privacy verklaring

*U bent uitgenodigd voor het invullen van de vragenlijst voor mijn afstudeeronderzoek naar de verschillende woonvoorkeuren en –motieven in Nederland. Ter herinnering, het invullen van de vragenlijst is totaal vrijwillig. Voordat u de vragenlijst in gaat vullen, vraag ik u om het informatieformulier te lezen: klik hier voor het informatieformulier. Als u over deze informatie vragen heeft, kunt u contact met mij opnemen via : j.w.m.poel@student.tue.nl. Mocht u geen vragen hebben en akkoord gaan met de verstrekte informatie, dan kunt u dit hieronder aangeven.

- (●) Ja, ik ga akkoord.
- ( ) Nee, ik ga niet akkoord.

Door dit toestemmingsformulier te ondertekenen erken ik dat ik voldoende ben geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Ik neem vrijwillig deel aan dit onderzoek. Het is mij duidelijk dat ik deelname aan het onderzoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil. Ik geef toestemming om de persoonsgegevens die gedurende het onderzoek bij mij worden verzameld te verwerken zoals is opgenomen in het bijgevoegde informatieblad.

Vorige   Volgende

Selectie vraag

*Bent u op dit moment professioneel betrokken bij het bouwen van woningen door middel van collectief particulier opdrachtgeverschap?

- ○ Ja
- ◉ Nee

Vorige | Volgende

Introductie vragen

Voordat u de vragenlijst in gaat vullen, wordt u gevraagd om de volgende vragen te beantwoorden zodat we een beter beeld krijgen van uw ervaring op de woningmarkt.

*Woont u op dit moment **zelfstandig of gezamenlijk**?

- ○ Zelfstandig (individueel, met een partner en/of met kinderen)
- ○ Gezamenlijk (wonend met huisgenoten)
- ○ Zeg ik liever niet

*Woont u op dit moment in een **koopwoning of huurwoning**?

- ○ Koopwoning
- ○ Huurwoning
- ○ Zeg ik liever niet

*Stelt u zich voor dat u gaat verhuizen. Hoe belangrijk vindt u dan de volgende eigenschappen van uw nieuwe woning?

	Erg onbelangrijk	Onbelangrijk	Neutraal	Belangrijk	Erg belangrijk
Locatie van de woning	○	○	○	○	○
Betere betaalbaarheid woning	○	○	○	○	○
Duurzamer wonen	○	○	○	○	○
Zelfstandig (blijven) wonen	○	○	○	○	○
Nabuurschap	○	○	○	○	○
Voorkomen van eenzaamheid	○	○	○	○	○
Makkelijker sociale relaties aangaan	○	○	○	○	○
Meer ontwerpvrijheid van de woning	○	○	○	○	○

Vorige | Volgende

Uitleg keuzetaak

Stelt u zich voor dat u zich in de beginfase bevindt van het bouwen van uw nieuwe woning. Deze woning gaat u bouwen via Collectief Particulier Opdrachtgeverschap, hierna aangegeven met CPO. Voordat u verder gaat, wordt u gevraagd om het volgende filmpje te kijken, dat uitlegt wat CPO inhoudt:

Druk op de 'Play' knop om het filmpje te beginnen. Het filmpje is met geluid (Nederlands gesproken). Bron: Youtube

In het proces voor het bouwen van uw nieuwe woning via CPO, heeft u al een groep gevonden met wie u collectief gaat bouwen. De volgende stap is om een locatie te vinden waar uw woning gebouwd gaat worden. Daarvoor krijgt u twee mogelijke locaties voorgelegd, locatie A en locatie B. Deze locaties verschillen op basis van 7 verschillende kenmerken. Daarnaast zijn er een aantal uitgangspunten die voor elke locatie hetzelfde zijn. Alle kenmerken en uitgangspunten vindt u op de volgende pagina, samen met een uitleg en de verschillende waarden die ze kunnen hebben.

Vorige Volgende

Kenmerken en niveaus

Er zijn een aantal uitgangspunten die voor elke optie van een locatie hetzelfde zijn. Op iedere locatiekeuze die u te zien krijgt, kunt u ervan uit gaan dat er 10 tot 25 standaard woningen worden gebouwd. Deze woningen zullen nieuwbouw woningen zijn met minimaal één parkeerplaats per woning. Daarnaast worden alle woningen voorzien van duurzame systemen, zoals zonnepanelen en het hergebruik van regenwater.

Voor een uitleg van de uitgangspunten, klik dan hier

Standaard woningen. De woningen die worden gebouwd op de locatie zullen 2 of 3 kamer woningen zijn.

Grootte project. Tijdens het onderzoek is er geconcludeerd dat 61% van alle CPO projecten een woningaantal heeft van 10-25 woningen. Dit wordt dan ook als constante waarde aangehouden.

Duurzaamheid. Subsidies voor CPO projecten worden voornamelijk gegeven aan CPO ontwikkelingen die een vorm van duurzaamheid hebben. Duurzame toepassingen zullen dan ook in iedere locatie aanwezig zijn. Voorbeelden zijn de aanwezigheid van zonnepanelen of een warmtepomp.

Nieuwbouw. Tijdens het onderzoek is er geconcludeerd dat 86-88% van alle CPO projecten in de groep 'nieuwbouwprojecten' valt. Dit wordt dan ook als constante waarde aangehouden.

Parkeermogelijkheden. Vaak is het een vereiste bij nieuwbouw projecten dat er voldoende parkeermogelijkheden aanwezig zijn. Daarom wordt er op iedere locatie minimaal één parkeerplaats voor uw huishouden gereserveerd.

Daarnaast zijn er ook kenmerken die verschillen per locatie. Deze kenmerken kunnen uw keuze van de woonlocatie beïnvloeden. Deze kenmerken kunt u hieronder vinden. Mocht u een toelichting willen van een kenmerken, dan kunt u op de desbetreffende kenmerk klikken.

1. Prijs voor de grond van een locatie

Hiermee worden de prijzen van de grondlocaties van de twee gegeven opties vergeleken. De (gemiddelde) prijzen van de grond voor het project kunnen zijn: a) 360 000 Euro, b) 400 000 Euro of c) 440 000 Euro.

2. Mate van stedelijkheid

De projectlocatie bevindt zich a) in een binnenstad, b) in de rand van de stad of c) in een dorp of op het platteland. Hoe hoger de stedelijkheid, des te meer voorzieningen in uw directe omgeving.

3. Afstand naar dichtstbijzijnde OV halte

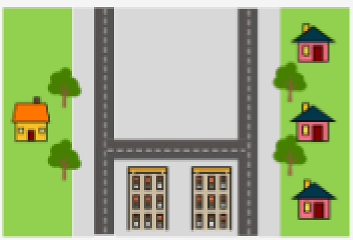
De projectlocatie bevindt zich op een bepaalde afstand van de dichtstbijzijnde OV halte, waar zowel een bus- als treinhalte mee kan worden bedoeld. De mogelijkheden zijn dat de locatie zich bevindt op een 5 minuten loopafstand (tot 400 meter) van een OV halte, op een 5 minuten fietsafstand (tot 1500 meter) of op een grotere afstand (meer dan 1500 meter).

4. Afstand naar dichtstbijzijnde supermarkt

De projectlocatie bevindt zich op een bepaalde afstand van de dichtstbijzijnde supermarkt. De mogelijkheden zijn dat de locatie zich bevindt op een 5 minuten loopaf-stand (tot 400 meter) van een supermarkt, op een 5 minuten fietsafstand (tot 1500 meter) of op een grotere afstand (meer dan 1500 meter).

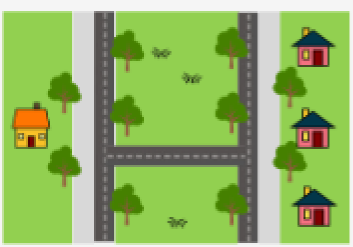
5. Groen in de omgeving

De projectlocatie bevindt zich in een omgeving waar een bepaalde hoeveelheid groen aanwezig is. Met groen worden zowel grasvelden, struiken en bomen bedoeld. De mogelijkheden zijn dat de omgeving van de projectlocatie a) weinig groen, b) engizins groen of c) erg groen is. Omdat deze termen weinig tot de verbeelding kunnen spreken, is er voor elke situatie een afbeelding beschikbaar als voorbeeld:



Weinig groen

Enigzins groen



Erg groen

6. Fietsen in de omgeving

De projectlocatie bevindt zich in een omgeving waar er een bepaalde kwaliteit is van het fietsnetwerk. Dit kan worden gemeten met de afstand tot een hoofdfietsnetwerk. Het hoofdfietsnetwerk bestaat vaak uit fietspaden die zijn gescheiden van de autowegen waardoor u op een snellere en veiligere manier kunt fietsen. De mogelijkheden zijn dat de locatie a) een erg goede verbinding heeft (toegang op minder dan 300 meter), b) een goede verbinding heeft (toegang op minder dan 1500 meter) of c) een matige verbinding heeft met het hoofdfietsnetwerk (toegang op meer dan 1500 meter).

7. Mogelijkheid tot gezamenlijke ruimtes

De projectlocatie bevindt zich op een stuk grond waar er een bepaalde mogelijkheid is om gezamenlijke ruimtes te bouwen. Met gezamenlijke ruimtes worden zowel ruimtes binnen als buiten bedoeld. Gezamenlijke binnenruimtes zijn bijvoorbeeld een gedeelde woonkamer, hobbykamer of wasruimte. Gezamenlijke buitenruimtes zijn bijvoorbeeld een groentetuin, gezamenlijke tuin of speelplaats. Het kan zijn dat er a) alleen de mogelijkheid is om gezamenlijke binnenruimtes te bouwen, b) alleen de mogelijkheid is om gezamenlijke buitenruimtes te bouwen of c) dat er zowel gezamenlijke binnen- als buitenruimtes kunnen worden gebouwd.

Vorige | Volgende

Voorbeeld keuzetaak

In het volgende deel van de vragenlijst wordt u 9 keer gevraagd om een keuze te maken tussen twee woonlocaties voor het bouwen van uw nieuwe woning door middel van CPO. U kunt hierbij kiezen tussen locatie A, locatie B of geen van de locaties wanneer ze beide u niet aanspreken. Er volgt eerst een voorbeeldvraag. Voordat u verder kunt, moet u de voorbeeldvraag beantwoorden.

*Stelt u zich voor dat u bezig bent een locatie te vinden waar uw nieuwe woning gebouwd gaat worden met een CPO project. Op iedere locatiekeuze die u te zien krijgt, kunt u ervan uit gaan dat er 10 tot 25 standaard woningen worden gebouwd op de locatie. Deze woningen zullen nieuwbouw woningen zijn met minimaal één parkeerplaats per woning. Daarnaast worden alle woningen voorzien van duurzame systemen, zoals zonnepanelen en een warmtepomp.

Welke woonlocatie zou u kiezen? Mocht geen van beide locaties u aanspreken, kies dan voor 'Geen van beide'.

Kenmerken	Woonlocatie A	Woonlocatie B
Prijs voor de grond	400 000 Euro	360 000 Euro
Mate van stedelijkheid	Binnenstad	Dorp of platteland
Afstand naar dichtstbijzijnde openbaar vervoer halte	Tot 5 minuten lopen	Meer dan 5 minuten fietsen
Afstand naar dichtstbijzijnde supermarkt	Tot 5 minuten lopen	Tot 5 minuten fietsen
Groen in de omgeving	Enigzins groene omgeving	Erg groene omgeving
Fietsen in de omgeving	Erg goede verbinding met fietsnetwerk	Goede verbinding met fietsnetwerk
Mogelijkheid van gezamenlijke ruimtes	Alleen mogelijkheid tot gezamenlijke binnenruimtes	Mogelijkheid tot zowel gezamenlijke binnen- en buitenruimtes

Ik kies voor:

Woonlocatie A | Woonlocatie B | Geen van beide

Vorige | Volgende

Keuzetaken

Hieronder volgen 9 keuzetaken.

*Stelt u zich voor dat u bezig bent een locatie te vinden waar uw nieuwe woning gebouwd gaat worden met een CPO project. Op iedere locatiekeuze die u te zien krijgt, kunt u ervan uit gaan dat er 10 tot 25 standaard woningen worden gebouwd op de locatie. Deze woningen zullen nieuwbouw woningen zijn met minimaal één parkeerplaats per woning. Daarnaast worden alle woningen voorzien van duurzame systemen, zoals zonnepanelen en het hergebruik van regenwater.

Welke woonlocatie zou u kiezen? Mocht geen van beide locaties u aanspreken, kies dan voor 'Geen van beide'.

Kenmerken	Woonlocatie A	Woonlocatie B
Prijs voor de grond	360 000 Euro	440 000 Euro
Mate van stedelijkheid	Binnenstad	Binnenstad
Afstand naar dichtstbijzijnde openbaar vervoer halte	Tot 5 minuten lopen	Tot 5 minuten lopen
Afstand naar dichtstbijzijnde supermarkt	Tot 5 minuten lopen	Meer dan 5 minuten fietsen
Groen in de omgeving	Weinig groen in de omgeving	Erg groene omgeving
Fietsen in de omgeving	Erg goede verbinding met fietsnetwerk	Matige verbinding met fietsnetwerk
Mogelijkheid van gezamenlijke ruimtes	Alleen mogelijkheid tot gezamenlijke binnenruimtes	Mogelijkheid tot zowel gezamenlijke binnen- en buitenruimtes

Ik kies voor:

Woonlocatie A | Woonlocatie B | Geen van beide

Such choice tasks were then presented nine times per individual. The build-up of these choice tasks can be seen in appendix D. In this appendix, only the first and last choice task will be shown.

*Stelt u zich voor dat u bezig bent een locatie te vinden waar uw nieuwe woning gebouwd gaat worden met een CPO project. Op iedere locatiekeuze die u te zien krijgt, kunt u ervan uit gaan dat er 10 tot 25 standaard woningen worden gebouwd op de locatie. Deze woningen zullen nieuwbouw woningen zijn met minimaal één parkeerplaats per woning. Daarnaast worden alle woningen voorzien van duurzame systemen, zoals zonnepanelen en het hergebruik van regenwater.

Welke woonlocatie zou u kiezen? Mocht geen van beide locaties u aanspreken, kies dan voor 'Geen van beide'.

Kenmerken	Woonlocatie A	Woonlocatie B
Prijs voor de grond	360 000 Euro	360 000 Euro
Mate van stedelijkheid	Aan de rand van de stad	Binnenstad
Afstand naar dichtstbijzijnde openbaar vervoer halte	Tot 5 minuten lopen	Tot 5 minuten lopen
Afstand naar dichtstbijzijnde supermarkt	Tot 5 minuten fietsen	Tot 5 minuten lopen
Groen in de omgeving	Enigzins groene omgeving	Weinig groen in de omgeving
Fietsen in de omgeving	Matige verbinding met fietsnetwerk	Erg goede verbinding met fietsnetwerk
Mogelijkheid van gezamenlijke ruimtes	Mogelijkheid tot zowel gezamenlijke binnen- en buitenruimtes	Alleen mogelijkheid tot gezamenlijke binnenruimtes

Ik kies voor:

Woonlocatie A | Woonlocatie B | Geen van beide

Vorige | Volgende

Ervaring en kennis met CPO

De volgende vragen gaan over uw kennis en ervaring met CPO. Deze vragen worden gesteld zodat we kunnen onderzoeken of ervaring met CPO een invloed heeft op de keuze van een woonlocatie.

*Had u, voor het invullen van deze vragenlijst, al eens **gehoord van CPO**?

- (●) Ja
- ( ) Nee

*Wat is uw **ervaring met CPO**?

- ( ) Ik heb wel gehoord van CPO maar heb er geen interesse in.
- ( ) Ik heb interesse in deelname aan een CPO project.
- ( ) Ik ben momenteel bezig in de initiatiefase (opstellen ontwerp, vinden groepsleden, aankopen grond/gebouw etc.) van een CPO project.
- (●) Ik ben momenteel bezig met de bouwfase van een CPO project.
- ( ) Ik woon in een woning gerealiseerd met een CPO project.

***Hoeveel woningen** worden / zijn er gebouwd tijdens uw CPO project?

- ( ) 2 t/m 9 woningen
- ( ) 10 t/m 14 woningen
- ( ) 15 t/m 19 woningen
- ( ) 20 t/m 24 woningen
- ( ) 25 of meer woningen
- ( ) Weet ik niet of zeg ik liever niet.

*Hieronder staan verschillende kenmerken van woningen. Geef per kenmerk aan wat voor invloed het heeft gehad in **uw keuze van de locatie** van uw CPO project. Dit doet u door per kenmerk aan te geven of het geen, weinig of veel invloed heeft gehad. Dit doet u door op de balk links (geen invloed), in het midden (weinig invloed) of rechts (veel invloed) te **klikken**.

Voldoende parkeerplaatsen op het terrein. — Geen invloed

Gezamenlijke binnenruimtes (bijvoorbeeld een werkruimte, washok of ontmoetingsruimte). — Geen invloed

Privétuin. — Geen invloed

Gezamenlijke buitentuin (hier valt ook een speelplaats of moestuin onder). — Geen invloed

Zonnepanelen, een warmtepomp of andere duurzame investeringen. — Geen invloed

Laadpunten voor elektrische auto's. — Geen invloed

Het bouwen van woningen op een leeg kavel. — Geen invloed

Het bouwen van woningen in een bestaand pand. — Geen invloed

Zijn er **andere kenmerken** van het CPO project die invloed hebben gehad op de keuze van de woonlocatie, die nog niet zijn benoemd in de vorige vraag? Als dit niet het geval is, kunt u deze vraag overslaan.

*Wat zijn de eerste vier cijfers van de **postcode** van de locatie van uw CPO project? Als u dit liever niet invult of als u nog geen locatie heeft gevonden, vul hieronder dan 0000 in.

*Hoe lang heeft het ongeveer geduurd voordat u een geschikte locatie had gevonden voor uw CPO project?

- ○ Minder dan één jaar.
- ○ Eén tot twee jaar.
- ○ Meer dan twee jaar.
- ○ Weet ik niet of zeg ik liever niet.

Vorige   Volgende

Persoonskenmerken

De volgende vragen gaan over uw persoonlijk kenmerken. Ter herinnering, alle vragen zijn vrijwillig in te vullen en de informatie wordt met volledige anonimiteit opgeslagen en gebruikt in het onderzoek. Deze vragen worden gesteld zodat we kunnen onderzoeken of verschillende persoonskenmerken invloed hebben op de woonlocatie keuze.

*Wat is uw **leeftijd**?

- (●) 24 jaar of jonger
- ( ) 25-34 jaar
- ( ) 35-44 jaar
- ( ) 45-54 jaar
- ( ) 55-64 jaar
- ( ) 65-74 jaar
- ( ) 75 jaar en ouder
- ( ) Zeg ik liever niet

*Wat is uw **nationaliteit**?

- ( ) Nederlands
- ( ) Europees (niet Nederlands)
- ( ) Buiten Europa
- ( ) Zeg ik liever niet

*Wat is uw **geslacht**?

- (●) Man
- ( ) Vrouw
- ( ) Ik identificeer me anders
- ( ) Zeg ik liever niet

*Wat is uw **hoogst genoten opleiding**?

- ( ) Basisschool
- ( ) VMBO
- ( ) HAVO-VWO
- ( ) MBO1
- ( ) MBO2
- ( ) MBO3
- ( ) MBO4
- ( ) HBO
- ( ) Universitair
- ( ) Zeg ik liever niet
- ( ) Anders: ________

*Wat is de **grootte van uw huishouden**?

- ◯ **Eén**persoonshuishouden
- ◯ **Twee**persoonshuishouden
- ◯ **Drie**persoonshuishouden
- ◯ Huishouden met **meer dan drie** personen
- ◯ Zeg ik liever niet

*Wat zijn de eerste vier cijfers van uw **huidige postcode**? U wordt gevraagd dit in te vullen zodat wij kunnen onderzoeken of de huidige woonomgeving invloed heeft op de keuze van de woonlocatie. Als u dit liever niet invult, vul hieronder dan 0000 in.

*Wat is het netto te besteden **inkomen per maand** in uw huishouden?

- ◯ Onder de 1500 Euro per maand
- ◯ Tussen de 1500 en 2000 Euro per maand.
- ◯ Tussen de 2000 en 2500 Euro per maand.
- ◯ Tussen de 2500 en 3000 Euro per maand.
- ◯ Tussen de 3000 en 3500 Euro per maand.
- ◯ Tussen de 3500 en 4200 Euro per maand.
- ◯ Boven de 4200 Euro per maand.
- ◯ Zeg ik liever niet

Vorige

Verzenden

Heel erg bedankt voor het invullen van deze vragenlijst. Mocht u nog vragen hebben, dan kunt u mij contacteren op j.w.m.poel@student.tue.nl. Mocht u de vragenlijst willen delen met vrienden, collega's, familie of andere geïnteresseerden in dit onderwerp, dan mag dat uiteraard!

Ethics document (Dutch)

Informatieblad voor onderzoek

1. Inleiding

U bent gevraagd om deel te nemen aan het onderzoek naar de woonvoorkeuren en –motieven, omdat u deze vragenlijst naar u is doorgestuurd door uw CPO adviseur of direct door de onderzoeker, J. Poel.

Deelname aan dit onderzoek is vrijwillig: u besluit zelf of u mee wilt doen. Voordat u besluit tot deelname, willen wij u vragen de volgende informatie door te lezen, zodat u weet waar het onderzoek over gaat, wat er van u verwacht wordt en hoe wij omgaan met de verwerking van uw persoonsgegevens. Op basis van die informatie kunt u middels de toestemmingsverklaring aangeven of u toestemt met deelname aan het onderzoek en met de verwerking van uw persoonsgegevens.

U bent natuurlijk altijd vrij om vragen te stellen aan de onderzoeker via j.w.m.poel@student.tue.nl of deze informatie te bespreken met voor u bekenden.

2. Doel van het onderzoek

Dit onderzoek wordt geleid door Jasper Poel. Het doel van dit onderzoek is om de motieven en voorkeuren van woonlocaties te analyseren met betrekking tot collectief particulier opdrachtgeverschap.

3. Verwerkingsverantwoordelijke in de zin van de AVG

TU/e is verantwoordelijk voor de verwerking van uw persoonsgegevens in het kader van het onderzoek. De contactgegevens van TU/e zijn:

Technische Universiteit Eindhoven
De Groene Loper 3
5612 AE Eindhoven

4. Wat houdt deelname aan de studie in?

U neemt deel aan een onderzoek waarbij we informatie zullen vergaren door:

- Wij vragen u om een vragenlijst in te vullen waarin naast enkele persoonlijke kenmerken, u wordt gevraagd om keuzetaken te voltooien. In deze keuzetaken wordt u gevraagd om de woonlocatie te kiezen uit twee opties, die voor u het meest aantrekkeling lijkt. Deze woonlocaties zullen verschillen op basis van 7 variabelen, die allen één van de drie mogelijkheden waardes hebben.

U ontvangt voor deelname aan dit onderzoek geen vergoeding.

5. Welke persoonsgegevens verzamelen en verwerken wij van u?

In verband met het onderzoek verwerken wij de volgende persoonsgegevens:

Categorie	Persoonsgegeven	Doeleinde
Contactinformatie	Postcode (alleen de cijfers) die uw woongebied aangeven.	Dit wordt gevraagd om de variabele "mate van stedelijkheid" mee te nemen in de studie.
Persoonlijke informatie	Leeftijd, geslacht, achtergrond, opleidingsniveau, inkomen en grootte van uw huishouden	Deze informatie wordt gevraagd om na te gaan of deze kenmerken invloed hebben (in het algemeen) op woonlocatie voorkeuren.
Ervaring met CPO	Uw kennis van- en ervaring met CPO ontwikkeling & kenmerken van een CPO project waarbij u betrokken was.	Deze informatie wordt gevraagd om na te gaan of kennis van- of ervaring met CPO ontwikkeling invloed heeft (in het algemeen) op woonlocatie voorkeuren.

6. Intrekken van toestemming en contactgegevens

Deelname aan dit onderzoek is geheel vrijwillig. U hoeft geen vragen te beantwoorden die u niet wilt beantwoorden. U kunt als deelnemer uw medewerking aan het onderzoek te allen tijde stoppen, of weigeren dat uw gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen. Het stopzetten van deelname heeft geen nadelige gevolgen voor u.

Als u tijdens het onderzoek besluit om uw medewerking te staken, zullen de gegevens die u reeds hebt verstrekt tot het moment van intrekking van de toestemming in het onderzoek gebruikt worden.
Wilt u stoppen met het onderzoek, of heeft u vragen en/of klachten? Neem dan contact op met de onderzoeker via j.w.m.poel@student.tue.nl .

Indien u specifieke vragen hebt over de omgang met persoonsgegevens kun u deze richten aan de functionaris gegevensbescherming van TU/e door een mail te sturen naar functionarisgegevensbescherming@tue.nl. U hebt daarnaast het recht om een klacht in te dienen bij de Autoriteit Persoonsgegevens.

Tot slot heeft u het recht een verzoek tot inzage, wijziging, verwijdering of aanpassing van uw gegevens te doen. Dien uw verzoek daartoe in via privacy@tue.nl.

7. Grondslag voor het verwerken van uw gegevens

Om uw persoonsgegevens te mogen verwerken, moet de verwerking gebaseerd zijn op één van de grondslagen uit de AVG. Voor het onderzoek *"Gebruik maken van een GIS gebaseerd multi-criteria aanpak voor het analyseren en identificeren van geschikte locaties voor collectief particulier opdrachtgeverschap projecten"* is dat uitdrukkelijke toestemming.

8. Wie heeft toegang tot uw persoonsgegevens?

Toegang tot persoonsgegevens binnen TU/e

Alle relevante werknemers die betrokken zijn bij het onderzoek hebben toegang tot uw persoonlijke gegevens, maar alleen voor zover noodzakelijk om hun respectievelijke taken te vervullen. Deze werknemers zijn *Dr. Ing. Peter van der Waerden* en *assistent professor Stephan Maussen* Verder zijn uw gegevens alleen toegankelijk voor bevoegde personen in de relevante afdelingen van de TU/e zoals IT, HR, Legal, Compliance of de Vertrouwenspersoon, maar alleen in zoverre het noodzakelijk is om hun respectievelijke taken te vervullen.

Toegang tot persoonsgegevens door andere partijen
In het kader van het onderzoek zullen uw persoonsgegevens worden gedeeld met:

- Opslagoplossing: BE Project Drive
- Survey tool: LimeSurvey
- Analysis tool: SPSS

Wanneer een derde partij uw persoonsgegevens verwerkt op onze instructies, dan is deze partij een verwerker. Wij gaan een overeenkomst aan met een dergelijke verwerker betreffende de verwerking van uw persoonsgegevens. Deze overeenkomst houdt in ieder geval in dat bepaalde verplichtingen ter bescherming van persoonsgegevens worden gehonoreerd, zodat zeker is dat de gegevens worden verwerkt met inachtneming van de wensen en standaarden van TU/e.

TU/e zal jouw gegevens alleen binnen de Europese Economische Ruimte ('EER') te verwerken door jouw gegevens op een server in de EER op te slaan.

9. Hoe worden uw persoonsgegevens beveiligd?

TU/e heeft passende technische en organisatorische maatregelen geïmplementeerd ter bescherming van de persoonsgegevens tegen onbedoelde of onrechtmatige vernietiging van de gegevens, onbedoelde schade, verlies, wijziging en ongeautoriseerde openbaring of toegang, en tegen alle andere vormen van onrechtmatige verwerking (inclusief, maar niet gelimiteerd tot niet noodzakelijke verzameling van gegevens) of verdere verwerking. Deze passende technische en organisatorische maatregelen houden in dat de data alleen toeganglijk is op beveiligde opslaglocaties via autorisatie en authenticatie & aan de hand van richtlijnen binnen de organisatie over het verwerken van persoonsgegevens.

10. Hoe lang worden uw persoonsgegevens bewaard?

Uw persoonsgegevens worden bewaard in overeenstemming met de AVG. De gegevens worden niet langer bewaard dan noodzakelijk om de doelen te bereiken waarvoor de gegevens verzameld zijn en worden verwijderd wanneer u uw toestemming intrekt en er geen andere grondslag is om uw gegevens rechtmatig te verwerken. Uw gegevens worden in ieder geval na 10 jaar verwijderd.

11. Vertrouwelijkheid van gegevens

Wij doen er alles aan uw privacy zo goed mogelijk te beschermen. De onderzoeksresultaten die gepubliceerd worden zullen op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u bevatten waardoor iemand u kan herkennen, tenzij u in ons toestemmingsformulier expliciet toestemming heeft gegeven voor het vermelden van uw naam, bijvoorbeeld bij een quote. De onderzoeksgegevens worden indien nodig (bijvoorbeeld voor een controle op wetenschappelijke integriteit) en alleen in anonieme vorm ter beschikking gesteld aan personen buiten de onderzoeks- groep.

Tot slot is dit onderzoek beoordeeld en goedgekeurd door de ethische commissie van de Technische Universiteit Eindhoven.

***** Scroll naar beneden voor het toestemmingsformulier *****

Toestemmingsformulier voor deelname volwassene

Door dit toestemmingsformulier te ondertekenen erken ik het volgende:

1. Ik ben voldoende geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Deze vragen zijn voldoende beantwoord.

2. Ik neem vrijwillig deel aan dit onderzoek. Er is geen expliciete of impliciete dwang voor mij om aan dit onderzoek deel te nemen. Het is mij duidelijk dat ik deelname aan het onderzoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil.

Daarnaast geef ik toestemming voor de volgende onderdelen van het onderzoek:

3. Ik geef toestemming om de persoonsgegevens die gedurende het onderzoek bij mij worden verzameld te verwerken zoals is opgenomen in het bijgevoegde informatieblad.
4. Ik geef toestemming voor de verwerking van bijzondere categorieen persoonsgegevens zoals opgenomen in paragraaf 5 van het informatieblad.
5. Ik geef toestemming om de bij mij verzamelde onderzoeksdata te bewaren en te gebruiken voor toekomstig onderzoek op het gebied van woonwensen waarbij erkende ethische normen voor wetenschappelijk onderzoek in acht worden genomen en voor onderwijsdoeleinden.

Appendix J: Full overview socio-demographic distribution and representativity

In this appendix, the full overview of the frequency and percentage distribution can be found for all included socio-demographic characteristics. In table 34 the frequencies can be found for the sample, while in table 35 the percentage distributions are compared with the CBS statistics.

Table 34: Full overview personal characteristics sample

Characteristic	All respondents		Respondents with no CPC experience		Respondents with CPC experience	
Age	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Under 25 years	30	18.4	28	41.8	2	2.1
25-34 years	18	11.0	14	20.9	4	4.2
35-44 years	20	12.3	2	3.0	18	18.8
45-54 years	18	11.0	5	7.5	13	13.5
55-64 years	30	18.4	8	11.9	22	22.9
65-74 years	37	22.7	7	10.4	30	31.3
75 years or older	10	6.1	3	4.5	7	7.3
Total	*163*	*100*	*67*	*100*	*96*	*100*
Nationality	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Dutch	161	98.8	66	98.5	95	99.0
Not Dutch	2	1.2	1	1.5	1	1.0
Total	*163*	*100*	*67*	*100*	*96*	*100*
Gender	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Male	80	49.4	35	52.2	45	46.9
Female	82	50.6	31	46.	51	53.1
Identify otherwise **	1	0.6	1	1.5	0	0.0
Total	*163*	*100*	*67*	*100*	*96*	*100*
Education level	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Lower level	10	6.1	7	10.4	3	3.1
Medium level	24	14.7	7	10.4	17	17.7
Higher level	129	79.1	53	79.1	76	79.2
Total	*163*	*100*	*67*	*100*	*96*	*100*
Household income level	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Low income	25	15.3	20	29.9	5	5.2
Medium income	56	34.4	20	29.9	36	37.5
High income	59	36.2	20	29.9	39	40.6
Rather not say**	23	14.1	7	10.4	16	16.7
Total	*163*	*100*	*67*	*100*	*96*	*100*

Household size	Frequency	Percent	Frequency	Percent	Frequency	Percent
One person	26	16.0	13	19.4	13	13.5
Two people	78	47.9	22	32.8	56	58.3
Three people	20	12.3	12	17.9	8	8.3
More people	39	23.9	20	29.9	19	19.8
Total	*163*	*100*	*67*	*100*	*96*	*100*
Urbanity level	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Very highly urban	31	19.0	18	26.9	13	13.5
Highly urban	42	25.8	11	16.4	31	32.3
Moderately urban	38	23.3	23	34.3	15	15.6
Slightly urban	22	13.5	4	6.0	18	18.8
Non-urban	16	9.8	4	6.0	12	12.5
Rather not say**	14	8.6	7	10.4	7	7.3
Total	*163*	*100*	*67*	*100*	*96*	*100*
Region*	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Northern and eastern provinces	19	11.6	4	6.0	15	15.6
Western provinces	44	27.0	9	13.4	35	36.5
Southern provinces	86	52.8	47	70.1	39	40.6
Rather not say**	14	8.6	7	10.4	7	7.3
Total	*163*	*100*	*67*	*100*	*96*	*100*

**The provinces are distributed as follows. Northern provinces include Friesland, Groningen and Drenthe. Eastern provinces include Gelderland, Flevoland and Overijssel. Western provinces include Utrecht, Noord-Holland, Zuid-Holland and Zeeland. Southern provinces include Noord-Brabant and Limburg.*

***These answer options have been excluded from the Chi-square test since they either have a count of 0 or distort the outcome sincerely.*

Table 35: Overview representativity

Characteristic	Sample distribution			Statistics CBS
	All respondents	Group without CPC experience	Group with CPC experience	Dutch population
Age	**Percentage**	**Percentage**	**Percentage**	**Percentage**
24 years or younger	18.4	41.8	2.1	28
25-34 years	11.0	20.9	4.2	13
35-44 years	12.3	3.0	18.8	12
45-54 years	11.0	7.5	13.5	13
55-64 years	18.4	11.9	22.9	14
65-74 years	22.7	10.4	31.3	11
75 years or older	6.1	4.5	7.3	9

Nationality	Percentage	Percentage	Percentage	Percentage
Dutch	98.8	98.5	99.0	74
Not Dutch	1.2	1.5	1.0	26
Gender	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Male	49.1	52.2	46.9	49.7
Female	50.3	46.3	53.1	50.3
Education level	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Lower level	6.1	10.4	3.1	28
Medium level	14.7	10.4	17.7	37
Higher level	79.1	79.1	79.2	35
Household income level	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Low income	17.9	33.3	6.3	40
Medium income	40.0	33.3	45.0	40
High income	42.1	33.3	48.8	20
Household size	**Percentage**	**Percentage**	**Percentage**	**Percentage**
One person	16.0	19.4	13.5	39
Two people	47.9	32.8	58.3	33
Three people	12.3	17.9	8.3	12
More than three people	23.9	29.9	19.8	17
Household size	**Percentage**	**Percentage**	**Percentage**	**Percentage**
One person	16.0	19.4	13	13.5
Two people	47.9	32.8	56	58.3
Three people	12.3	17.9	8	8.3
More than three people	23.9	29.9	19	19.8
Urbanity level	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Very highly urban	20.8	30.0	14.6	26
Highly urban	28.2	18.3	34.8	30
Moderately urban	25.5	38.3	16.9	16
Slightly urban	14.8	6.7	20.2	21
Non-urban	10.7	6.7	13.5	7
Region	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Northern and eastern provinces	12.8	6.7	16.9	31
Western provinces	29.7	15	39.3	48
Southern provinces	57.4	78.3	43.8	21
Living situation	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Living independently	76.1	67.2	82.3	96
Living with others	23.9	32.8	17.7	4
Tenure situation	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Rental	19.6	34.3	9.4	42
Owner-occupied	80.4	65.7	90.6	57

Appendix K: Detailed provincial distribution

The detailed provincial distribution, from the descriptive analysis, can be seen in table 36.

Table 36: Provincial distribution

Region	Frequency	Percent	Frequency	Percent	Frequency	Percent
Friesland	1	0.6	0	0.0	1	1.0
Gelderland	15	9.2	3	4.5	12	12.5
Limburg	16	9.8	3	4.5	13	13.5
Noord-Brabant	70	42.9	44	65.7	26	27.1
Noord-Holland	6	3.7	5	7.5	1	1.0
Overijssel	3	1.8	1	1.5	2	2.1
Utrecht	28	17.2	1	1.5	27	28.1
Zeeland	1	0.6	1	1.5	0	0.0
Zuid-Holland	9	5.5	2	3.0	7	7.3
Groningen	0	0.0	0	0.0	0	0.0
Drenthe	0	0.0	0	0.0	0	0.0
Flevoland	0	0.0	0	0.0	0	0.0
Rather not say	14	8.6	7	10.4	7	7.3
Total	*163*	*100*	*67*	*100*	*96*	*100*

Appendix L: Complete discrete choice models

The full overview of the MNL model can be seen in table 37. .

Table 37: Detailed MNL model output

Statistic	Value
Log likelihood function	-1454.41
Restricted log likelihood (null model)	-1641.33
Log likelihood (constants only)	-1606.85
Inf. Cr. AIC. (2936.8 AIC/N)	1.966
R-squared (constants only)	0.0955
R-squared (null model)	0.2223
R-square adjusted (constants only)	0.0860
R-square adjusted (null model)	0.2142

Attribute level	Coefficient	Standard Error	Z	Prob.	95% confidence interval
Constant	.415	.063	6.550	.000	.291 .539
Price = 360 000 EU	.182	.062	2.950	.003	.061 .302
Price = 400 000 EU	.120	.057	2.120	.034	.009 .232
Price = 440 000 EU	-0.302	-	-	-	-
Inner city	-.203	.060	-3.380	.001	-.321 -.085
Edge of city	.166	.055	3.050	.002	.059 .273
Village or countryside	0.037	-	-	-	-
5 minute walk to PT stop	.098	.059	1.680	.094	-.017 .213
10 minute walk to PT stop	.186	.054	3.440	.001	.080 .291
15 minute walk to PT stop	-0.284	-	-	-	-
5 minute walk to supermarket	.051	.058	0.890	.376	-.062 .165
5 minutes cycling to supermarket	-.036	.058	-0.620	.537	-.149 .078
>5 minutes cycling to supermarket	-0.015	-	-	-	-
Low level of green	-.712	.058	-12.250	.000	-.826 -.598
Medium level of green	.0602	.057	1.060	.291	-.052 .172
High level of green	0.652	-	-	-	-
Very good connection with cycling network	-.245	.058	-4.210	.000	-.359 -.131
Good connection with cycling network	.0499	.060	0.830	.404	-.067 .167
Poor connection with cycling network	0.195	-	-	-	-
Possibility of communal indoor spaces	-.224	.064	-3.520	.000	-.349 -0.010
Possibility of communal outdoor spaces	0.068	.066	-1.030	.303	-.198 .062
Possibility of both communal indoor- and outdoor spaces	0.156	-	-	-	-

Estimation is based on N=1494 and K = 15. Dependent variable is 'choice'.
***, **, * = significant at 1%, 5%, 10% level.

Table 38: Detailed LC model output

Statistic	Value
Log likelihood function	-1276.45
Restricted log likelihood	-1641.33
Log likelihood (constants only)	-1606.85
Inf. Cr. AIC. (2614.9 AIC/N)	1.750
Chi squared [31](P=.000)	729.75
McFadden Pseudo R-squared	0.222
R-squared (constants only)	0.2056
R-squared (null model)	0.2223
R-square adjusted (constants only)	0.1973
R-square adjusted (null model)	0.2142

LC Group 1					
Attribute level	Coefficient	Standard Error	Z	Probability	95% confidence interval
Constant	3.268	0.370	8.840	0.000	2.544 3.992
Price = 360 000 EU	0.522	0.160	3.260	0.001	0.208 0.836
Price = 400 000 EU	0.103	0.117	0.880	0.377	-0.126 0.332
Price = 440 000 EU	-0.625	-	-	-	-
Inner city	0.245	0.151	1.620	0.105	-0.051 0.541
Edge of city	0.492	0.116	4.230	0.000	0.264 0.720
Village or countryside	-0.737	-	-	-	-
5 minute walk to PT stop	0.134	0.117	1.140	0.254	-0.096 0.364
10 minute walk to PT stop	0.124	0.110	1.130	0.259	-0.092 0.340
15 minute walk to PT stop	-0.258	-	-	-	-
5 minute walk to supermarket	0.052	0.127	0.410	0.683	-0.198 0.301
5 minutes cycling to supermarket	-0.038	0.111	-0.340	0.736	-0.255 0.180
>5 minutes cycling to supermarket	-0.014	-	-	-	-
Low level of green	-0.997	0.124	-8.020	0.000	-1.240 -0.753
Medium level of green	0.186	0.150	1.240	0.214	-0.107 0.479
High level of green	0.811	-	-	-	-
Very good connection with cycling network	-0.318	0.130	-2.440	0.015	-0.574 -0.063
Good connection with cycling network	0.076	0.136	0.560	0.576	-0.190 0.342
Poor connection with cycling network	0.242	-	-	-	-
Possibility of communal indoor spaces	0.204	0.133	1.530	0.125	-0.057 0.466
Possibility of communal outdoor spaces	-0.384	0.151	-2.530	0.011	-0.680 -0.087
Possibility of both communal indoor- and outdoor spaces	0.179	-	-	-	-

LC Group 2					
Attribute level	Coefficient	Standard Error	Z	Probability	95% confidence interval
Constant	2.330	0.382	6.100	0.000	1.581 3.080
Price = 360 000 EU	0.034	0.225	0.150	0.879	-0.406 0.474
Price = 400 000 EU	0.240	0.263	0.910	0.360	-0.275 0.755
Price = 440 000 EU	-0.274	-	-	-	-
Inner city	-1.818	0.356	-5.110	0.000	-2.516 -1.121
Edge of city	-0.433	0.257	-1.680	0.092	-0.937 0.071
Village or countryside	2.252	-	-	-	-
5 minute walk to PT stop	0.197	0.248	0.790	0.427	-0.289 0.682
10 minute walk to PT stop	0.388	0.197	1.980	0.048	0.003 0.774
15 minute walk to PT stop	-0.585	-	-	-	-
5 minute walk to supermarket	0.592	0.283	2.090	0.037	0.036 1.147
5 minutes cycling to supermarket	-0.409	0.197	-2.080	0.038	-0.795 -0.023
>5 minutes cycling to supermarket	-0.183	-	-	-	-
Low level of green	-0.744	0.216	-3.440	0.001	-1.168 -0.321
Medium level of green	0.105	0.245	0.430	0.669	-0.375 0.585
High level of green	0.640	-	-	-	-
Very good connection with cycling network	-0.166	0.201	-0.830	0.408	-0.560 0.228
Good connection with cycling network	-0.391	0.240	-1.630	0.103	-0.862 0.079
Poor connection with cycling network	0.558	-	-	-	-
Possibility of communal indoor spaces	-0.728	0.317	-2.300	0.022	-1.349 -0.107
Possibility of communal outdoor spaces	0.391	0.302	1.290	0.196	-0.202 0.984
Possibility of both communal indoor- and outdoor spaces	0.337	-	-	-	-

LC Group 3					
Attribute level	Coefficient	Standard Error	Z	Probability	95% confidence interval
Constant	-1.148	0.215	-5.330	0.000	-1.570 -0.726
Price = 360 000 EU	0.017	0.197	0.090	0.932	-0.369 0.403
Price = 400 000 EU	0.461	0.205	2.250	0.024	0.060 0.862
Price = 440 000 EU	-0.478	-	-	-	-
Inner city	-2.107	0.358	-5.890	0.000	-2.808 -1.405
Edge of city	0.468	0.168	2.780	0.005	0.138 0.797
Village or countryside	1.639	-	-	-	-
5 minute walk to PT stop	0.064	0.216	0.300	0.767	-0.360 0.488
10 minute walk to PT stop	0.521	0.192	2.720	0.007	0.146 0.897

15 minute walk to PT stop	-0.585	-	-	-	-
5 minute walk to supermarket	-0.385	0.215	-1.790	0.073	-0.806 0.036
5 minutes cycling to supermarket	0.072	0.207	0.350	0.728	-0.334 0.478
>5 minutes cycling to supermarket	0.313	-	-	-	-
Low level of green	-2.499	0.378	-6.600	0.000	-3.241 -1.758
Medium level of green	0.078	0.202	0.380	0.700	-0.318 0.473
High level of green	2.422	-	-	-	-
Very good connection with cycling network	-0.252	0.197	-1.280	0.201	-0.638 0.134
Good connection with cycling network	0.024	0.200	0.120	0.904	-0.367 0.416
Poor connection with cycling network	0.228	-	-	-	-
Possibility of communal indoor spaces	-1.063	0.312	-3.410	0.001	-1.673 -0.452
Possibility of communal outdoor spaces	0.707	0.331	2.140	0.032	0.060 1.355
Possibility of both communal indoor- and outdoor spaces	0.355	-	-	-	-
LC Group 4					
Attribute level	**Coefficient**	**Standard Error**	**Z**	**Probability**	**95% confidence interval**
Constant	-1.280	0.167	-7.680	0.000	-1.607 -0.953
Price = 360 000 EU	0.358	0.183	1.950	0.051	-0.001 0.718
Price = 400 000 EU	-0.149	0.167	-0.890	0.371	-0.477 0.178
Price = 440 000 EU	-0.209	-	-	-	-
Inner city	0.871	0.186	4.680	0.000	0.506 1.236
Edge of city	0.180	0.186	0.960	0.335	-0.185 0.545
Village or countryside	-1.051	-	-	-	-
5 minute walk to PT stop	0.180	0.183	0.990	0.324	-0.178 0.539
10 minute walk to PT stop	0.086	0.175	0.490	0.625	-0.257 0.428
15 minute walk to PT stop	-0.266	-	-	-	-
5 minute walk to supermarket	0.173	0.177	0.980	0.327	-0.173 0.519
5 minutes cycling to supermarket	0.291	0.163	1.780	0.075	-0.029 0.611
>5 minutes cycling to supermarket	-0.464	-	-	-	-
Low level of green	-0.040	0.192	-0.210	0.835	-0.417 0.337
Medium level of green	-0.183	0.192	-0.950	0.341	-0.559 0.193
High level of green	0.223	-	-	-	-
Very good connection with cycling network	-0.157	0.178	-0.880	0.379	-0.506 0.192
Good connection with cycling network	0.129	0.170	0.760	0.449	-0.205 0.463

Poor connection with cycling network	0.028	-	-	-	-	
Possibility of communal indoor spaces	-0.610	0.194	-3.150	0.002	-0.990	-0.230
Possibility of communal outdoor spaces	-0.734	0.207	-3.550	0.000	-1.140	-0.329
Possibility of both communal indoor- and outdoor spaces	1.345	-	-	-	-	

Estimation is based on N=1494. Dependent variable is 'choice'.
***, **, * = significant at 1%, 5%, 10% level.

Appendix M: Overview model performance LC models

In this appendix, the model performance values for three LC models can be seen in table 39. Here model performance indicators can be seen for a latent class analysis consisting of two, three and four classes. This has been used to determine what LC model has the highest scoring model performance and should thus be used in the thesis. Here can be seen that the LC model with four classes performs better since the log likelihood has a value closer to 0 and a higher rho-squared value.

Table 39: Overview LC model performances

Statistic	LC model 2 classes	LC model 3 classes	LC model 4 classes
Log likelihood function	-1276.450	-1199.424	-1157.751
Restricted log likelihood	-1641.327	-1641.327	-1641.327
Log likelihood (constants only)	-1606.853	-1606.853	-1606.853
Inf. Cr. AIC. (2443.5 AIC/N)	1.750	1.669	1.636
Chi squared [63](P=.000)	729.755	883.805	965.152
McFadden Pseudo R-squared	0.222	0.269	0.294
Rho-squared (final model versus constants only)	0.206	0.254	0.279
Rho-squared (final model versus null model)	0.222	0.269	0.294
Rho-squared adjusted (final model versus constants only)	0.197	0.242	0.263
Rho-squared adjusted (final model versus null model)	0.214	0.258	0.279

Appendix N: Full overview socio-demographic distribution LC groups

In this appendix, the full overview of the distribution of all, thus also insignificant, socio-demographic characteristics can be found concerning the LC groups. These results can be seen in table 40.

Table 40: Overview socio-demographic distribution LC groups

Characteristic	LC group 1	LC group 2	LC group 3	LC group 4
Age	**Percentage**	**Percentage**	**Percentage**	**Percentage**
24 years or younger	28.1	23.3	6.1	5.6
25-34 years	18.8	10.0	6.1	2.8
35-44 years	9.4	16.7	18.2	8.3
45-54 years	14.1	0.0	12.1	13.9
55-64 years	10.9	20.0	24.2	25.0
65-74 years	12.5	13.3	33.3	41.7
75 years or older	6.3	16.7	0.0	2.8
Nationality	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Dutch	100.0	100.0	90.9	100.0
Not Dutch	0.0	0.0	9.1	0.0
Gender	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Male	48.4	66.7	51.5	36.1
Female	51.6	33.3	48.5	63.9
Education level	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Lower level	4.7	23.3	15.2	13.9
Medium level	6.3	10.0	12.1	8.3
Higher level	89.1	66.7	72.7	77.8
Household income level	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Low income	25.0	10.0	9.1	8.3
Medium income	31.3	40.0	27.3	41.7
High income	31.3	36.7	45.5	36.1
Rather not say	12.5	13.3	18.2	13.9
Household size	**Percentage**	**Percentage**	**Percentage**	**Percentage**
One person	20.3	3.3	9.1	25.0
Two people	35.9	70.0	48.5	50.0
Three people	15.6	3.3	15.2	11.1
More than three people	28.1	23.3	27.3	13.9
Prior CPC knowledge	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Yes	64.1	70.0	87.9	86.1
No	35.9	30.0	12.1	13.9

Experience with CPC	Percentage	Percentage	Percentage	Percentage
Heard of CPC but no interest in it.	17.2	13.3	6.1	2.8
Only interested in CPC	6.3	3.3	3.0	5.6
In initiation phase	9.4	13.3	21.2	13.9
In development phase	3.1	13.3	18.2	22.2
Living in dwellings realized with CPC	28.1	26.7	39.4	41.7
Living status	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Living independently	73.3	78.8	83.3	73.3
Living with others	26.7	21.2	16.7	26.7
Tenure status	**Percentage**	**Percentage**	**Percentage**	**Percentage**
Owner-occupied	93.3	84.8	88.9	93.3
Rental	6.7	15.2	11.1	6.7

Appendix O: Redefining output for price of land

In this appendix the input and results can be found for the analysis used to redefine the output for the price of land so it could be used in the suitability analysis. The input for the new LC model can be found in figure 41 while the new weights of LC group 3 can be found in figure 42.

```
RESET
read ; Nobs   = 4482
     ; Nvar   = 18
     ; Names  = icas,ialt,icho,icon,
                ipr1,ipr2,ist1,ist2,iha1,iha2,isu1,isu2,
                igr1,igr2,ifi1,ifi2,iru1,iru2
     ; Format = (f7.0,17f4.0)
     ; File   = Model.dat$

create; if (ipr1=1) pric=360$
create; if (ipr1=0) pric=400$
create; if (ipr1=-1) pric=440$


CREATE ; p1 = 0 ; p2 = 0 ; p3 = 0 ; p4 = 0$
NAMELIST ; cp = p1,p2, p3, p4$
DISCRETECHOICE;Lhs = icho
              ;Choices = 1,2,3
              ;Rhs     = icon,
                         pric,ist1,ist2,iha1,iha2,isu1,isu2,
                         igr1,igr2,ifi1,ifi2,iru1,iru2
              ;lcm
              ;classp=cp
              ;pds=9
              ;pts=4
              ;Maxit=10000$
```

Figure 41: Input redefined MNL model

```
        |Random utility parameters in latent class -->> 3..................
  ICON|3|     1.53164***       .14346     10.68  .0000      1.25046   1.81282
  PRIC|3|     -.00937***       .00226     -4.14  .0000      -.01380   -.00493
  IST1|3|     -.37110***       .07316     -5.07  .0000      -.51450   -.22770
  IST2|3|     -.04034          .10102      -.40  .6897      -.23834    .15766
  IHA1|3|      .05930          .11505       .52  .6062      -.16619    .28479
  IHA2|3|      .19877**        .09697      2.05  .0404       .00872    .38882
  ISU1|3|      .10996          .10184      1.08  .2803      -.08964    .30956
  ISU2|3|     -.22701**        .11436     -1.99  .0471      -.45115   -.00286
  IGR1|3|     -.45562***       .07346     -6.20  .0000      -.59961   -.31164
  IGR2|3|     -.13906          .09475     -1.47  .1422      -.32477    .04665
  IFI1|3|     -.23760*         .12527     -1.90  .0579      -.48312    .00792
  IFI2|3|      .09648          .11442       .84  .3991      -.12779    .32074
  IRU1|3|      .06336          .12470       .51  .6114      -.18105    .30777
  IRU2|3|     -.26817**        .12774     -2.10  .0358      -.51853   -.01781
```

Figure 42: Output redefined MNL model

In the output can be seen that the price attribute has a significant coefficient of -0.00937. This means that with every increase in price (of 1000 Euro's), the utility decreases with 0.00937.

Appendix P: Willingness-to-pay

In table 41 an overview can be seen of the willingness-to-pay for all attribute levels of the MNL model for the whole sample. To determine the WTP the negative of the coefficients will be divided by -0.00937. This gives the WTP by thousand Euro's. For example, the WTP for living in an inner city area is -224.9. This means that people want to pay 224,900 Euro' less for the ground in the inner city for a similar plot in another urbanity level.

Table 41: Willingness-to-pay results

Attribute level	Coefficient	WTP	Meaning
Inner city	-2.107	-224.9	People want to pay 224,900 Euro's less for a plot in the inner city
Edge of city	0.468	49.9	People willing to pay 49,900 Euro's more for a plot on the edge of a city
Village or countryside	1.639	174.9	People willing to pay 174,900 Euro's more for a plot on the edge of a city
5 minute walk to PT stop	0.064	6.8	People willing to pay 6,800 Euro's more if the plot is at a 5-minute walking distance from a PT stop
10 minute walk to PT stop	0.521	55.6	People willing to pay 55,600 Euro's more if the plot is at a 10-minute walking distance from a PT stop
15 minute walk to PT stop	-0.585	-62.4	People want to pay 62,400 Euro's less if the plot is at a 15-minute walking distance from a PT stop
5 minute walk to supermarket	-0.385	-41.1	People want to pay 41,400 Euro's less if the plot is at a 15-minute walking distance from a PT stop
5 minutes cycling to supermarket	0.072	7.7	People willing to pay 7,700 Euro's more if the plot is at a 5-minute cycling distance from a supermarket
>5 minutes cycling to supermarket	0.313	33.4	People willing to pay 33,400 Euro's more if the plot is at a more than 5-minute cycling distance from a supermarket
Low level of green	-2.499	-266.7	People want to pay 266,700 Euro's less if the plot is in a low-green neighbourhood.
Medium level of green	0.078	8.3	People willing to pay 8,300 Euro's more if the plot is in a medium-green neighbourhood
High level of green	2.422	258.5	People willing to pay 258,500 Euro's more if the plot is in a highly-green neighbourhood
Very good connection with cycling network	-0.252	-26.9	People want to pay 26,900 Euro's less if the plot has a very good connection with the cycling network
Good connection with cycling network	0.024	2.6	People willing to pay 2,600 Euro's more if the plot has a good connection with the cycling network

Poor connection with cycling network	0.228	24.3	People are willing to pay 24,300 Euro's more if the plot has a poor connection with the cycling network
Possibility of communal indoor spaces	-1.063	-113.4	People want to pay 113,400 Euro's less if the plot only has the possibility of communal indoor spaces.
Possibility of communal outdoor spaces	0.707	75.5	People willing to pay 75,500 Euro's more if the plot has the possibility of communal outdoor spaces.
Possibility of both communal spaces	0.355	37.9	People willing to pay 37,900 Euro's more if the plot has the possibility of both communal indoor- as outdoor spaces.

Appendix Q: Expressions to calculate suitability score

Here, all used expressions can be found that were used to calculate both the individual utility scores as the final utility score.

Independent attribute 1 – price of the plot

```
CASE
WHEN “Price of plot” > 0 AND “Price of plot” < 400,000 THEN 0.461 + ((400,000 – “Price of plot”) * 0.00937 / 1000)
WHEN “Price of plot” = 400,000 THEN 0.461
WHEN “Price of plot” > 400,000 AND “Price of plot” < 1,500,000 THEN 0.461 - ((“Price of plot” – 400,000 ) * 0.00937 / 1000)
ELSE NULL
END
```

Independent attribute 2 – level of urbanity

```
CASE
WHEN  “urbanity_level” = 1 THEN -2.107
WHEN “urbanity_level” = 2 OR “urbanity level” = 3 THEN 0.468
WHEN “urbanity_level” = 4 OR “urbanity level” = 5 THEN 1.639
END
```

Independent attribute 3 – distance to closest PT stop

```
CASE
WHEN  “distance PT” < 400 THEN 0.064
WHEN “distance PT” > 400 AND “distance PT” < 800 THEN 0.521
WHEN “distance PT” > 800 AND “distance PT” < 1200 THEN -0.585
WHEN  “distance PT” > 1200 THEN -9999
END
```

Independent attribute 4 – distance to closest supermarket

```
CASE
WHEN  “distance supermarket” < 400 THEN -0.385
WHEN “distance supermarket” > 400 AND “distance supermarket” < 1500 THEN 0.072
WHEN “distance supermarket” > 1500 AND “distance supermarket” < 3000 THEN 0.313
WHEN  “distance supermarket” > 3000 THEN -9999
END
```

Independent attribute 5 – green in the area

```
CASE
WHEN  “green_area” = ‘high’ THEN 2.422
WHEN “green_area” = ‘medium’ THEN 0.078
WHEN “green_area” = ‘low’ THEN -2.499
END
```

Independent attribute 6 – cycling network

```
CASE
WHEN  “distance cycling_network” < 600 THEN -0.252
WHEN “distance cycling_network” > 600 AND “distance cycling_network” < 1500 THEN
0.024
WHEN “distance cycling_network” > 1500 AND “distance cycling_network” < 3000 THEN
0.228
WHEN  “distance cycling_network “ > 3000 THEN -9999
END
```

Independent atttibute 7 – communal spaces / area

```
CASE
WHEN  “area” < 1375 THEN -9999
WHEN “area” > 1375 AND “area” < 1475 THEN -1.063
WHEN “area” > 1475 AND “area” < 1575 THEN 0.707
WHEN  “area “ > 1575 THEN 0.355
END
```

Final formula

```
CASE
WHEN  "UtilityPT" = -9999 OR  "UtilityPri" = NULL OR  "UtilitySup" = -9999 OR  "UtilityCyc"
= -9999 OR  "UtilityAre" = -9999 OR  "UtilityUrb" = -9999 THEN NULL
ELSE  "UtilitySup" + "UtilityPri" + "UtilityPT" + "UtilityGro" + "UtilityCyc" + "UtilityAre" +
"UtilityUrb"
END
```

Appendix R: Set-up online interactive tool

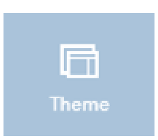
The ArcGIS software has a wide range of user types, member roles and privileges. Which type, role or privilege is required depends on what you want to do with the software. To construct an interactive web application, several items need to be created: a hosted feature layer, a web map and the web app. To do this, the developer needs an ArcGIS Pro account with user types 'Viewer', 'Editor' and 'Creator' (ESRI, n.d.-b). Furthermore, to be able to edit, use and publish data, the creator needs to have the member roles 'Data Editor', 'User' and 'Publisher'.

Once all required user types and member roles are granted, the first step in building the tool is to add content. More specifically, hosted feature layers needed to be added. These layers allow for larger datasets to be included in both the web map as web app. For this tool, all vector data layers needed to be exported from the QGIS file into a shapefile, for them to be uploaded to the ArcGIS environment. This has been done for all individual vector layers (green in the area, cycling network, public transport stops, supermarkets, urbanity and the final plot-file including all relevant information). Furthermore, vector data layers locating all buildings and cadastre boundaries were accessed through the ArcGIS database.

Now all relevant data layers were accessible in the ArcGIS environment, a web map can be created. This is necessary since the Web App Builder requires a web map as the base layer. In this web map, all necessary data layers were added. For every layer, the visual styles (what colour, what feature to show) could be altered in the web map and would automatically change in the web app. Likewise, the default view settings (what data layers to view once opening the app and the ranges of visibility) could be altered in the web map to be automatically changed in the web app. Also, here, the legend and shown labels or attribute names could be altered in the web map. This was necessary to do since the shapefile attribute names were all in English, and the target group of the tool are Dutch inhabitants desiring to live exclusively in the province Noord-Brabant. Measuring units were set to meters.

Finally, the tool itself could be built in the WebApp Developer software. This software consists of four main components: the theme-, map-, widget- and attribute tab. For every tab, the used aspects of every page will now be explained.

Theme



In the theme tab, the key visual components of the tool can be chosen. In total, there were ten themes to choose from, each having different lay-outs of what widgets to include and where they would be located on the screen. In the development of this tool, the tab-theme has been chosen.

Map

The map tab was used to import the relevant base map (created in the web map) and to set the default extent of the map. Once the correct web map has been imported and the default-extent was set to 'Use standard extent of the webmap', this tab had no further use.

Widget

Perhaps the most important tab that was is used is the widget tab. In this tab, (custom) widgets could be added to the application. In the tool development, a widget can also be described as a functionality. Every widget added to the application will be further explained in section 8.3.2.

Attribute

The attribute tab was used the least in this tool development. It was only used to change the title (located in the header) and subtitle of the web app.

Appendix S: Online interactive tool

In this appendix, all detailed information can be seen that has been used when developing the online app.

Information

The following text has been presented to the users. This text is presented only in Dutch.

"Welkom bij de Geschiktheid modeller - een digitaal hulpmiddel ontworpen voor het makkelijker vinden van geschikte locaties voor het bouwen van uw woning(en) via CPO. Daarnaast kan het gebruikt worden door iedereen die op zoek is naar de ideale woonlocatie! Hieronder vindt u meer informatie over hoe- en wanneer u de modeller het beste kunt gebruiken.

Let op: in de modeller worden locaties aangeduid door middel van percelen uit bestemmingsplannen - het kan zijn dat actuele percelen kleiner zijn. De grenzen van actuele percelen kunt u zien door de kaartlaag KadasterGrenzen aan te vinken.

De geschiktheid modeller kan op twee manieren worden gebruikt: 1) op zichzelf of 2) in combinatie met het GeschiktheidAnalyse bestand:

De modeller kan op zichzelf gebruikt worden als u antwoord wilt op de vraag: Zijn er geschikte woon- of ontwikkellocaties voor mij binnen mijn zoekgebied?

Heeft u binnen uw zoekgebied meerdere geschikte locaties gevonden? Dan kan het GeschiktheidAnalyse bestand van pas komen. Door dit bestand te gebruiken kunt u erachter komen welke van deze locaties het meest geschikt voor u is én waarom! Dit bestand kunt u downloaden door hier te klikken. U downloadt een Microsoft Excel bestand met een grootte van 204 MB. Het downloaden, openen en werken met dit bestand vereist dan ook geduld zo nu en dan. Welke stappen u moet volgen vindt u in het bestand zelf. Zodra u gebruik gaat maken van dit bestand, sluit de modeller dan niet! U heeft beide namelijk nodig.

Voor het gebruik van de modeller kunt u het beste de volgende stappen volgen:

1. Selecteer het gebied waarin u wilt zoeken. Dit kunt u doen op twee manieren: door het scrollen met uw muis totdat u uw gewenste zoekgebied heeft gevonden of door het zoeken met de Zoek functie bovenin het scherm.

2. Open de Filter functie bovenin het scherm. U kunt deze functie gebruiken voor het vinden van acceptabele locaties van percelen. U kunt bijvoorbeeld filteren op grootte en prijs van het perceel, afstand naar de supermarkt en huidige functie van het perceel. Zodra u een filter activeert, worden percelen die hieraan voldoen automatisch aangepast.

Goed om te weten: in de huidige versie van de modeller kunt u alleen gebruik maken van de volgende kenmerken van het perceel: oppervlakte, geschatte prijs, stedelijkheidsniveau, mate van groen in de omgeving, afstand tot dichtstbijzijnde OV halte, supermarkt en fietsnetwerk.

Tip: Heeft u nog geen idee hoe groot de oppervlakte van uw perceel dient te zijn? Dan kunt u ook het GeschiktheidAnalyse bestand downloaden. Hierin bevindt zich namelijk een calculator voor het berekenen van de minimale perceeloppervlakte!

3. Voor het vinden van geschikte percelen voor ontwikkeling is het handig om de precieze perceelkaders te vinden, net als percelen die al (deels) bebouwd zijn. Voor het zien van de actuele perceelkaders - open de kaartlaag KadasterGrenzen. Voor het zien van actuele gebouwen - open de kaartlaag Bebouwd. Dit kunt u doen door bovenaan in het scherm de functie Kaartlagen te openen.

4. Optioneel: Mocht u voor de gevonden percelen bijv. willen zien wat de afstand is naar de supermarkt of hoe groen de omgeving is, dan kan dat! Gebruik hiervoor de Selecteer functie bovenin het scherm. Zodra u het perceel heeft geselecteerd, open dan de Locatie informatie functie (eveneens bovenin het scherm). Hierin ziet u verschillende kenmerken van de locatie.

5. Optioneel: Mocht u voor de gevonden percelen de geschiktheidsscore in de kaart willen visualiseren, dan kan dit via de functie Kaart optimaliseren.

6. Optioneel: U kunt uw gegenereerde kaart ook opslaan voor toekomstig gebruik. Dit kunt u doen door gebruik te maken van de functie Afdrukken.

In figure 43 can be seen how the online tool looks like if the information-tab has been selected.

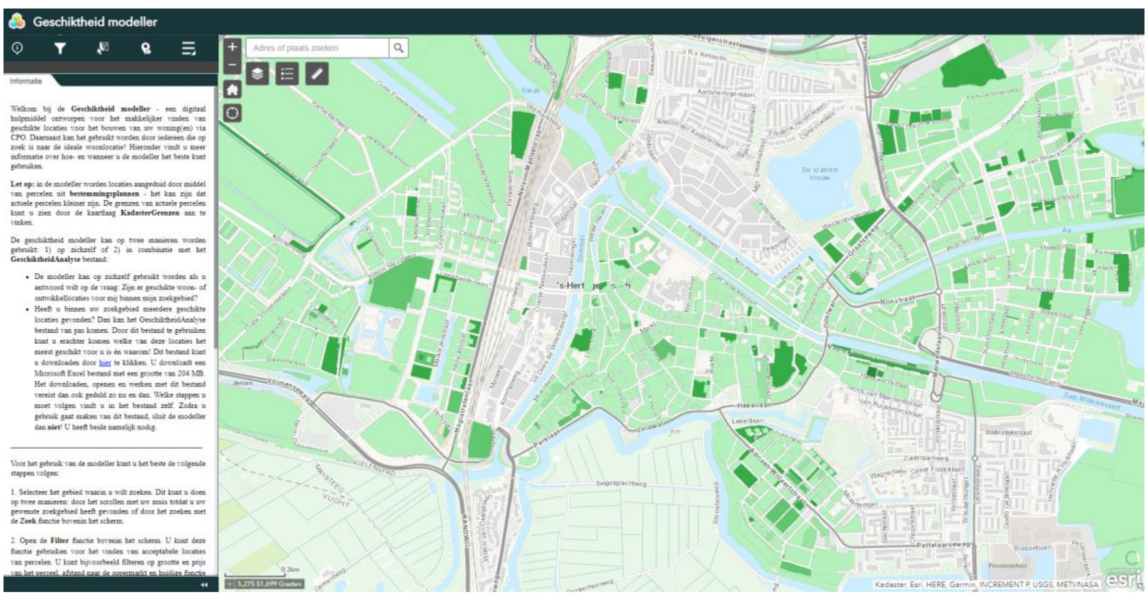


Figure 43: Online tool: information tab

Search
In figure 44 can be seen how the online tool looks like if the search-function is in use.

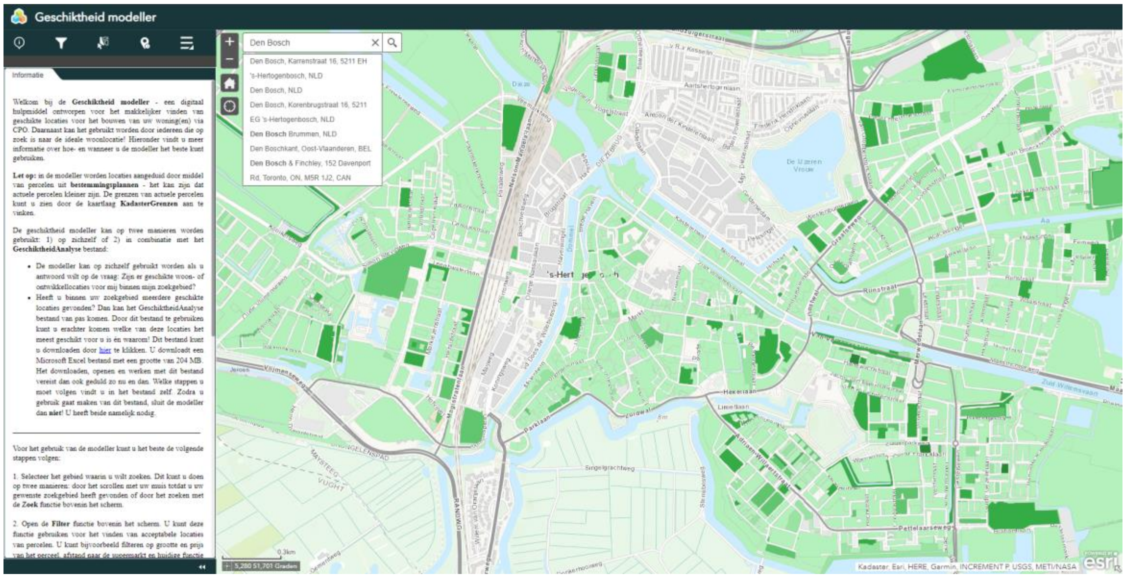


Figure 44:Online tool: search function

Filters
For every filter to work appropriately, the correct labels and expressions needed to be set. These can be found below:

Size area
The label used for this filter reads: “Eis: grootte perceel”. Two expressions needed to be made, one for the minimum and one for the maximum area. In the expression for the minimum desired area, the selected attribute should be “Oppervlakte perceel” that “is at least” a value that is asked for. The used prompt is “Oppervlakte perceel (in m2) is minimaal”. Likewise, for the expression of the maximum desired area, the selected attribute should be “Oppervlakte perceel” that “is at most” a value that is asked for. The used prompt then is “Oppervlakte perceel (in m2) is maximaal”.

Percentage of plot already built
The label used for this filter reads: “Eis: % bebouwd”. In the expression, the attribute should be “% van plot bebouwd” that “is at most” a value that is asked for. The used prompt is: “Percentage van het perceel oppervlak dat al is bebouwd mag maximaal zijn:”. A tip is also given which tells the user to set the percentage to 0 if they would only like to include plots with no buildings on them at all.

Price
The label used for this filter reads: “Eis: prijs perceel”. Here, in the expression, the attribute should be “Geschatte totaal prijs” that “is at most” a value that is asked for. The used prompt is: “Geschatte totaal prijs perceel (in Euro) is maximaal”.

Urbanity
The label used for this filter reads: "Eis: Stedelijkheid". In this expression, the attribute should be set to "Mate van stedelijkheid" that "is any of" predefined multiple values. These predefined multiple values are "Zeer sterk stedelijk", "Sterk stedelijk", "Matig stedelijk", "Weinig stedelijk" and "Niet stedelijk".

Maximum distance to supermarket
The label used for this filter reads: "Eis: maximale afstand naar supermarket". In this expression, the attribute should be set to "Afstand naar dichtstbijzijnde supermarkt" that "is at most" a value that is asked for. The used prompt is "Afstand naar dichtstbijzijnde supermarket (meter) is maximaal".

Maximum distance to public transport stop
The label used for this filter reads: "Eis: maximale afstand naar OV halte". In this expression, the attribute should be set to "Afstand naar dichtstbijzijnde OV halte" that "is at most" a value that is asked for. The used prompt is "Afstand naar dichtstbijzijnde OV halte (meter) is maximaal".

Maximum distance to cycling network
The label used for this filter reads: "Eis: maximale afstand naar fietsnetwerk". In this expression, the attribute should be set to "Afstand naar fietsnetwerk" that "is at most" a value that is asked for. The used prompt is "Afstand naar fietsnetwerk (meter) is maximaal".

Level of green
The label used for this filter reads: "Eis: hoeveelheid groen in de omgeving". In this expression, the attribute should be set to "Mate van groen in omgeving" that "is any of" predefined multiple values. These predefined multiple values are "Weinig groen in de buurt", "Gemiddeld groen in de buurt" and "Veel groen in de buurt".

Current landuse
The label used for this filter reads: "Huidige bestemmingsfunctie". In this expression, the attribute should be set to "Huidige bestemmingsfunctie" that "is any of" predefined multiple values. There are a multitude of options, which include e.g. "kantoor" and "wonen".

Current landuse (detailed)
The label used for this filter reads: "Huidige bestemmingsfunctie (gedetailleerd)". In this expression, the attribute should be set to "naam" that "is any of" predefined multiple values. There are a multitude of options, which include e.g. "garageboxen" and "parkeren".

In figure 45 can be seen how the online tool looks like if the filter-function is in use.

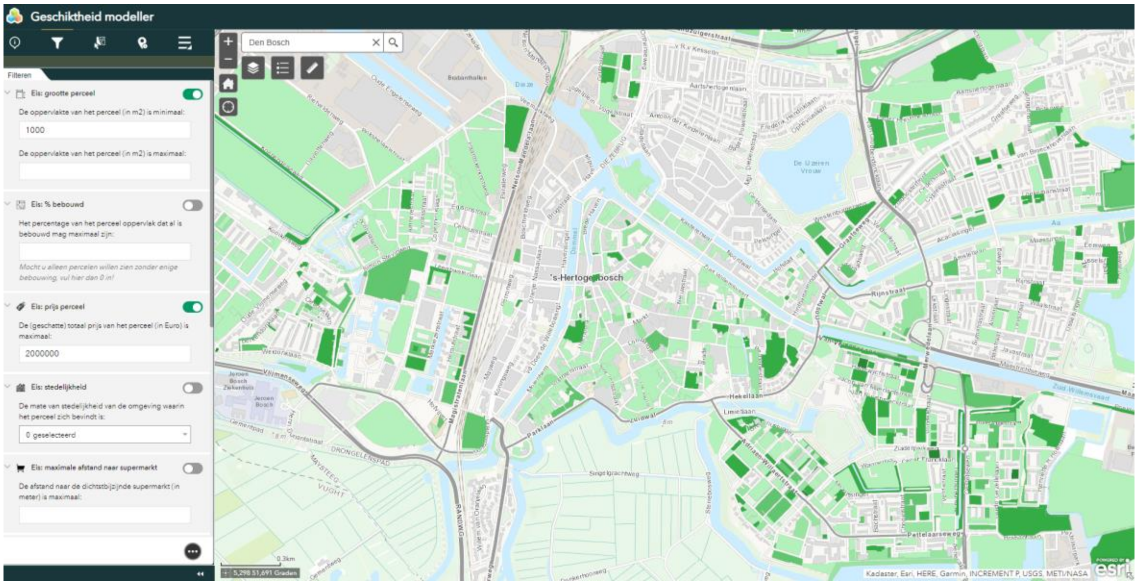


Figure 45: Online tool: filter function

Layer visibility

In figure 46 can be seen how the online tool looks like if the layer visibility function is in use.

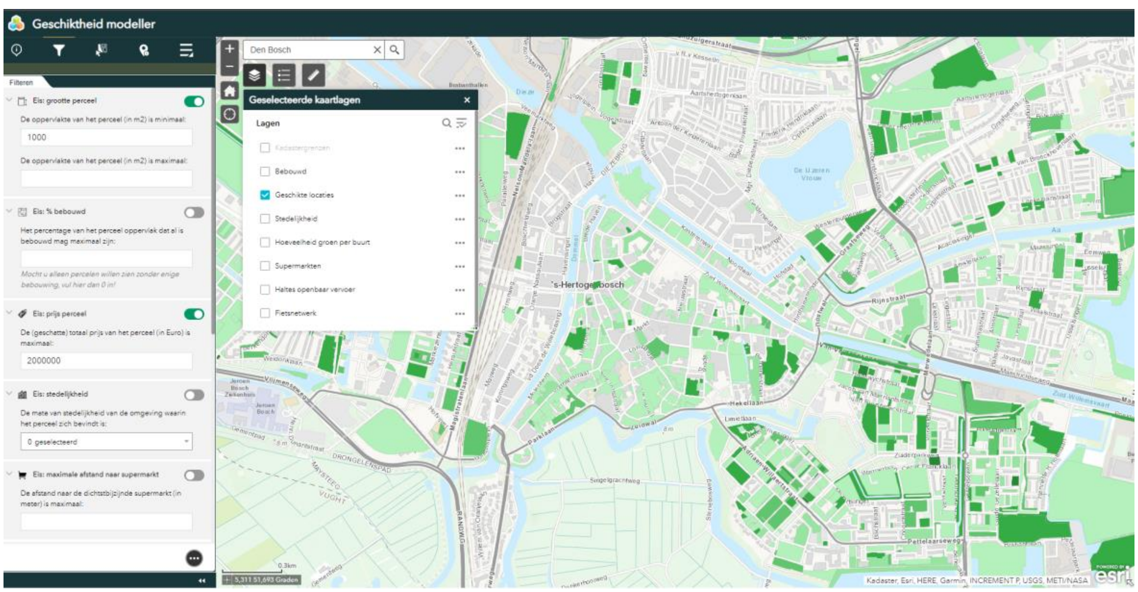


Figure 46: Online tool: layer visibility function

Select

In figure 47 can be seen how the online tool looks like if the selection function is in use.

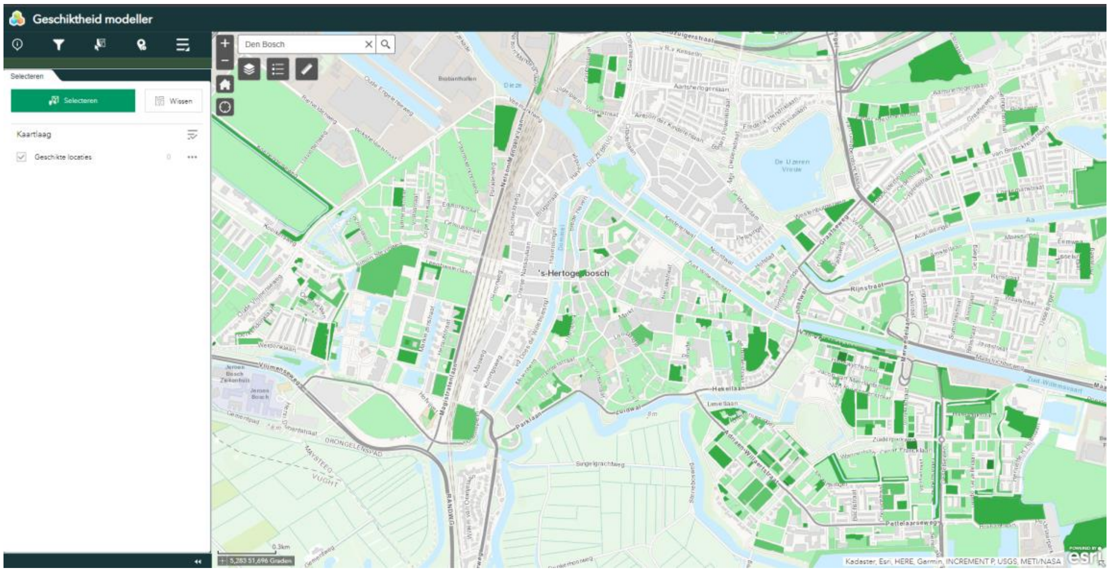


Figure 47: Online tool: selection function

Location information

In figure 48 is visible how the online tool looks like if the location information function is in use.

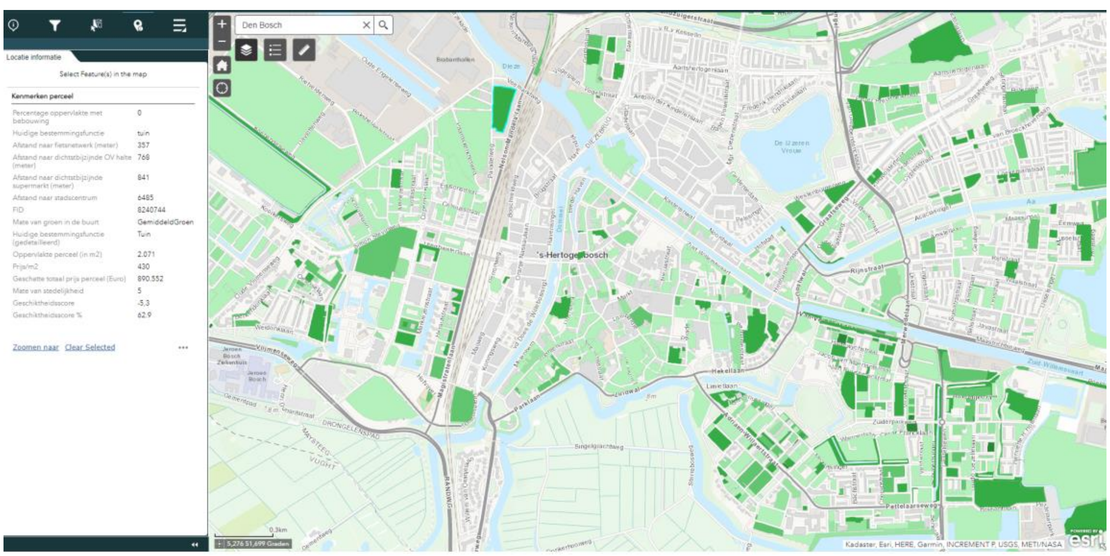


Figure 48: Online tool: location information function

Map optimization

In figure 49 can be seen how the online tool looks like if the map optimization function is in use. On the left, information is given of how this function can be used.

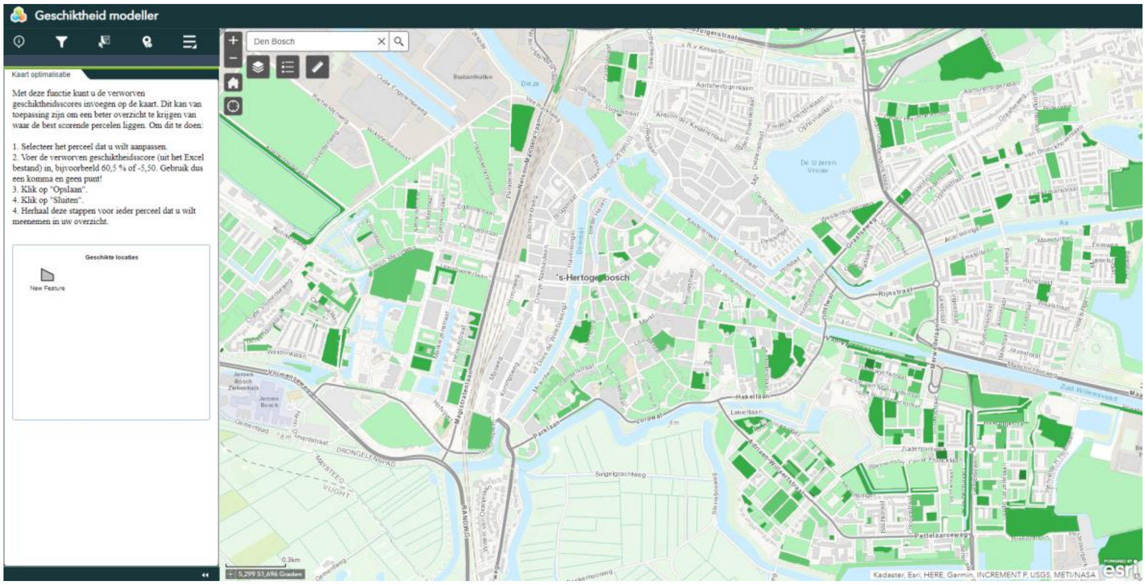


Figure 49: Online tool: map optimization function

Print

In figure 50 can be seen how the online tool looks like if the print function is in use.

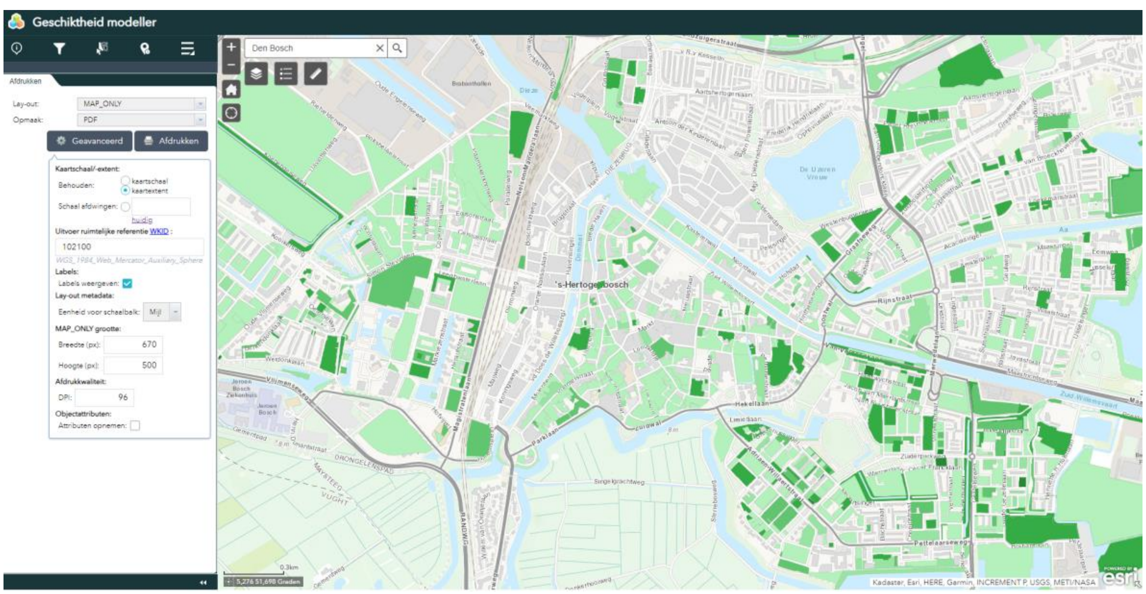


Figure 50: Online tool: print function

Measure

In figure 51 can be seen how the online tool looks like if the measuring function is in use.

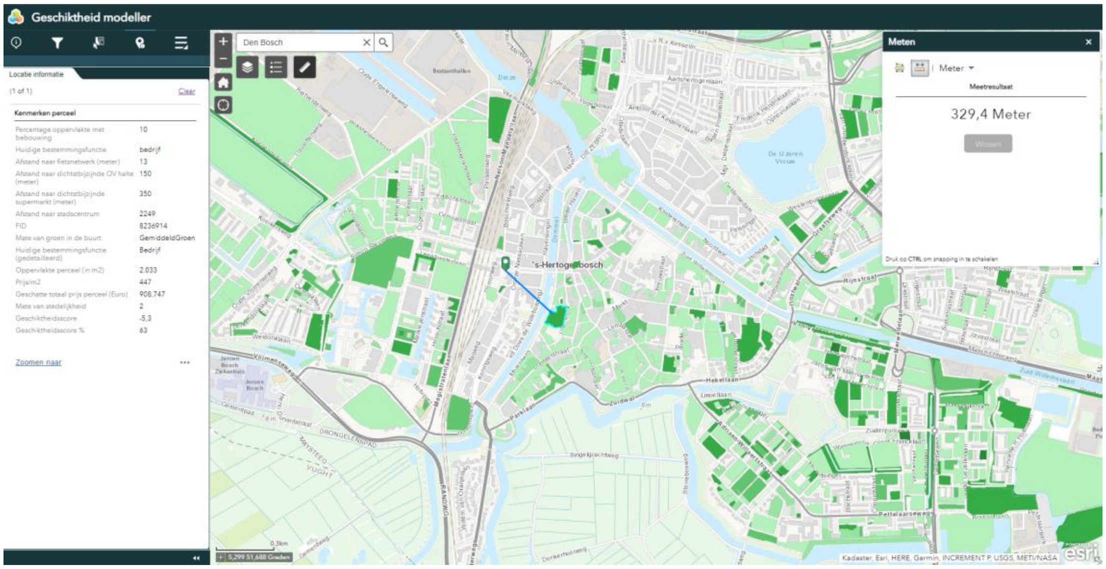


Figure 51: Online tool: measuring function

Appendix T: Excel-based suitability assessment

In this appendix the detailed contents of the suitability assessment document can be found. All showed contents in this appendix are displayed in Dutch only. Important in this file is that every cell that may be adjusted has a soft yellow file. Users are repeatedly reminded that any other cell may not be edited as it might harm the output of the analysis.

Information

In the information page of the document the following information can be found in figure 52.

Informatieblad

Welkom in het analyse-bestand van de *Geschiktheid modeller*. Dit bestand kan worden gebruikt als u meer dan één geschikte locaties heeft gevonden binnen uw zoekgebied & u erachter wilt komen welke van deze percelen het meest geschikt voor u zou zijn.

Opbouw van het bestand

Dit bestand is opgebouwd uit meerdere paginas: Informatie, Calculator, Analyse, Data en Resultaten. Hieronder kunt u vinden waarvoor elke pagina gebruikte dient te worden. Op de pagina's zelf kunt u vinden hoe u de functies kunt gebruiken of moet interpreteren.

Calculator

U kunt gebruik maken van deze pagina als u nog geen idee heeft over hoe groot uw perceel minimaal moet zijn om uw gewenste project te verwezenlijken. Het invullen van deze pagina resulteert in een minimaal perceeloppervlakte.

Analyse

Het wordt geadviseerd om deze pagina goed door te nemen en te gebruiken. Op deze pagina kunt u namelijk bepalen welke variabelen u mee wilt nemen en hoe belangrijk u deze variabelen vindt. De resultaten worden automatisch aangepast.

Data

Op deze pagina vindt u alle benodigde data voor het uitvoeren van de analyse. De data is specifiek klaargemaakt voor deze analyse door de ontwikkelaar. U kunt hier o.a. informatie vinden over de mate van stedelijkheid, groen en verschillende afstanden naar bijv. supermarkten. **Deze pagina dient niet aangepast te worden, dit kan ervoor zorgen dat de analyse mislukt!**

Resultaten

Op deze pagina kunt u verschillende resultaten vinden. U kunt hier het totaal aantal geschikte percelen in de provincie Noord-Brabant vinden en hoe deze percelen over het algemeen scoren op basis van de ingevulde criteria. Daarnaast kunt u deze pagina gebruiken om per gevonden perceel in de *Geschiktheid modeller* te kijken of het geschikt is voor uw beoogd project - of om erachter te komen **waarom** het perceel niet geschikt is.

Figure 52: Suitability document: information page

Calculator

The visual contents of the calculator page can be found in figure 53. In this page, the grey text indicates several types of areas that can be included in the suitability assessment.

Gebruik calculator

Mocht u nog geen idee hebben hoe groot het perceel minimaal moet zijn, dan kunt u de (oppervlakte) calculator gebruiken. Hierin hoeft u alleen aan te geven hoeveel woningen u wilt bouwen, hoe groot deze minimaal moeten zijn, hoeveel oppervlak aan gezamenlijke ruimtes nodig is en hoeveel woonlagen er gebouwd dienen te worden. U kunt dit aangeven in de geel gemarkeerde velden. **Pas voor de rest niks aan - dit kan ervoor zorgen dat de analyse mislukt!**

Wonen		
In ons CPO project gaan wij	10	woningen bouwen
Per woning gaan wij uit van een oppervlakte van	90	m2*
Totaal oppervlakte wonen	900	m2
Totaal oppervlakte parkeren	375	m2

Gezamenlijke ruimtes		
In ons CPO project willen wij totaal	80	m2 aan gezamenlijke binnenruimtes
In ons CPO project willen wij totaal	200	m2 aan (gezamenlijke) buitenruimtes**
Totaal oppervlakte gezamenlijke ruimtes	280	m2

Verdiepingen		
In ons CPO project wordt er gebouwd in	1	bouwlagen.

Minimale oppervlakte		
Minimale gebruiksoppervlakte (totaal)	1555	m2
Minimale perceelgrootte	**1555**	**m2**

* Onder deze oppervlakte valt ook een eventueel balkon.
** Onder deze oppervlakte valt ook het totale oppervlakte voor privé-tuinen.

Gezamenlijke binnenruimtes kunnen zijn: washok, gezamenlijke kamer etc.
Gezamenlijke buitenruimtes kunnen zijn: moestuin, gezamenlijke tuin etc.

Voor alleen gezamenlijke binnenruimtes moet het perceel minimaal	1355	m2 zijn.
Voor alleen gezamenlijke buitenruimtes moet het perceel minimaal	1475	m2 zijn.
Voor alle gezamenlijke ruimtes moet het perceel minimaal	1555	m2 zijn.
Voor geen gezamenlijke ruimtes moet het perceel minimaal	1275	m2 zijn.

Figure 53: Suitability document: calculator

Analysis

The visual contents of the analysis-page in the suitability assessment document can be found in figure 54. First, the users find information on the contents of this page and a brief explanation of the concept 'suitability analysis'. After this they are able to adjust the attributes to include, the importance of every attribute and the default values for land prices.

Variabelen en scorewaardes

ⓘ Op deze pagina vindt u welke variabelen en scorewaardes worden gebruikt in de geschiktheid-analyse. Deze variabelen en waardes staan ingesteld op de standaardwaardes verleend uit een onderzoek gedaan door de ontwikkelaar. U kunt deze variabelen en waardes aanpassen - dit kan in de geel gemarkeerde velden. **Maak geen veranderingen in een andere cel - dit kan ervoor zorgen dat de analyse mislukt!** U kunt eerst aanpassen welke variabelen u mee wilt nemen in de analyse. Mocht u een variabele niet mee willen nemen, kunt u dat doen door *Nee* te selecteren bij de gewenste variabele in sectie A (klik hiervoor op het veld). Vervolgens kunt u aangeven hoe belangrijk u de verschillende variabelen vind. Dit kunt u aangeven in sectie B (klik hiervoor op het veld). Aanpassingen in sectie B worden automatisch doorgerekend naar de resultaten pagina Een reden voor het gebruiken van een eigen waarde kan zijn dat u meer of minder belang hecht aan een bepaalde kwaliteit van de locatie. U kunt de prijs per vierkante meter grond ook aanpassen a.h.v. de gegeven waardes binnen uw gemeente. Doet u dit niet, dan worden gemiddelde waardes aangehouden. Daarnaast wordt aangeraden om onderin deze pagina de maximale acceptabele prijs van de grond aan te geven, dit kan de resultaten positief beinvloeden.

Hoe werkt de geschiktheid-analyse?

ⓘ De geschiktheid-analyse is gebaseerd op drie cruciale aspecten: 1) welke variabelen worden meegenomen in de analyse (bijv. Afstand naar een supermarkt), 2) wat is de waarde van deze variabele (bijv. 400 meter) en 3) welke scores de bepaalde variabelen kunnen krijgen (bijv. Als de afstand kleiner is dan 800 meter - krijgt deze variabele een score van 1). Des te hoger de score - des te belangrijker u deze waarde van de variabele vindt. Per meegenomen variabele kan er dusdanig een score worden verkregen - die afhankelijk is van de waarde van de variabele. De totale geschiktheid-score van een perceel is het resultaat van de som van alle individuele (variabele) scores. Het is ook mogelijk dat het perceel ongeschikt is voor uw wensen - doordat een van de waardes van de meegenomen variabelen buiten de acceptabele kaders ligt (bijv. Afstand naar een supermarkt is 5 kilometer). In zo'n geval is het perceel ongeschikt. In deze analyse kunt u dit herkennen aan een *FALSE* waarde. Om de totaalscores beter te interpreteren, kan het noodzakelijk zijn om deze scores te vertalen naar de relatieve score ten opzichte van de hoogst- en laagst mogelijke score. Hiervoor vindt u in de resultaten-pagina de waarde *% van MaxScore* .

A. De volgende variabelen wil ik meenemen in de analyse	Meenemen?
Grootte perceel	Ja
Prijs perceel	Ja
Stedelijkheid	Ja
Groen in de omgeving	Ja
Afstand dichtstbijzijnde OV halte	Ja
Afstand dichtstbijzijnde supermarkt	Ja
Afstand tot fietsnetwerk	Ja

B. De volgende variabelen wil ik aanpassen	Mate van belang
Grootte perceel	Gebruik standaard waardes
Prijs perceel	Gebruik standaard waardes
Stedelijkheid	Gebruik standaard waardes
Groen in de omgeving	Gebruik standaard waardes
Afstand dichtstbijzijnde OV halte	Gebruik standaard waardes
Afstand dichtstbijzijnde supermarkt	Gebruik standaard waardes
Afstand tot fietsnetwerk	Gebruik standaard waardes

Mocht u een variabele niet hebben meegenomen in deel A, dan hoeft u dit niet nogmaals aan te passen in deel B. Dit wordt automatisch doorberekend.

C. Standaardwaarden (aanpasbaar)	Waarde te gebruiken	
Prijs van de grond voor gebieden binnen 5 kilometer afstand van stadscentrum.	447	Euro/m2
Prijs van de grond voor gebieden op 5 tot 10 kilometer afstand van stadscentrum.	430	Euro/m2
Prijs van de grond voor gebieden op 10 tot 15 kilometer afstand van stadscentrum.	400	Euro/m2
Prijs van de grond voor gebieden op 15 tot 20 kilometer afstand van stadscentrum.	327	Euro/m2
Prijs van de grond voor gebieden op meer dan 20 kilometer afstand van stadscentrum.	290	Euro/m2

D. De volgende maximale waardes wil ik toepassen	
De maximale prijs (in Euro) voor het perceel is	3000000
De maximale afstand (in meter) van het perceel naar een OV halte is	
De maximale afstand (in meter) van het perceel naar een supermarkt is	
De maximale afstand (in meter) van het perceel naar het fietsnetwerk is	

Overzicht	
Laagst mogelijke totaalscore	-20.543
Hoogst mogelijke totaalscore	1.644
Verschil hoogst en laagst mogelijke totaalscore	22.187
1% groei van de totaalscore per stijging van	0.22187

Figure 54: : Suitability document: analysis page

Data

In figure 55 the first 40 rows of the data-page can be found. For ease in usability several columns have been hidden. For the whole dataset, see the *GeschiktheidAnalyse* file.

	A	B	K	N	O	P	Q	R	S	T	U
1	FID	Bestemming	Oppervlakte	Prijs per m2	PrijsPerceel	Groen per buurt	Stedelijkheid	Afstand stadscentrum	Afstand supermarkt	Afstand OV	Afstand fietsnetwerk
2	108090	wonen	1650	430	709289	Weinig	3	7811	782	750	452
3	119314	agrarisch	42145	447	18838842	Gemiddeld	5	3996	1679	1415	692
4	119315	agrarisch	18277	430	7859007	Gemiddeld	5	6905	1943	121	71
5	119316	wonen	2073	430	891197	Gemiddeld	3	8340	893	896	92
6	119319	wonen	5099	447	2279141	Gemiddeld	5	2832	1585	72	43
7	119321	wonen	589	430	253433	Veel	3	6552	1306	836	25
8	119322	agrarisch	9510	447	4251100	Gemiddeld	5	4271	1104	485	243
9	119323	wonen	2075	400	830084	Veel	5	11334	1414	1444	878
10	119324	agrarisch	12241	430	5263716	Veel	5	5438	1184	921	935
11	119325	wonen	3213	430	1381745	Veel	5	5795	2351	510	494
12	119326	agrarisch	13269	430	5705859	Veel	5	8932	3863	697	348
13	119328	wonen	1834	447	819820	Veel	5	4578	1524	1148	27
14	119329	agrarisch	5248	430	2256494	Gemiddeld	5	7746	2568	895	664
15	119330	agrarisch	10451	430	4494081	Weinig	3	9837	1136	1111	62
16	119331	wonen	1218	430	523848	Gemiddeld	5	7018	1980	102	86
17	119332	agrarisch	174	447	77988	Veel	5	4503	2179	1804	304
18	119333	agrarisch	26737	400	10694764	Veel	5	11473	2029	1758	573
19	119334	agrarisch	12500	400	5000124	Veel	5	12950	7578	2377	82
20	119335	agrarisch	57486	430	24718817	Veel	3	5217	2064	1251	869
21	119338	agrarisch	116292	430	50005504	Veel	5	6847	3028	881	219
22	119339	agrarisch	144021	430	61929241	Veel	3	6961	1346	639	296
23	119340	wonen	2682	430	1153316	Veel	5	6977	2922	919	309
24	119341	agrarisch	37982	430	16332071	Veel	5	5915	3468	1028	380
25	119342	agrarisch	11575	430	4977383	Veel	3	8879	2129	1457	262
26	119343	wonen	2550	447	1139792	Veel	3	4403	1473	1065	25
27	119344	agrarisch	348016	400	139206468	Veel	5	11379	6300	853	769
28	119345	agrarisch	486563	430	209221879	Gemiddeld	3	7678	1235	1082	822
29	119346	wonen	1418	430	609878	Veel	3	6685	1430	686	29
30	119347	agrarisch	43250	430	18597341	Gemiddeld	5	8176	3051	355	229
31	119348	wonen	1673	400	669040	Veel	5	10852	5834	508	200
32	119349	agrarisch	341016	430	146636919	Veel	5	8568	4579	3087	644
33	119350	groen	3418	400	1367392	Veel	5	13551	5634	502	8
34	119351	agrarisch	52904	447	23647949	Veel	5	2705	1533	1843	251
35	119352	wonen	6106	430	2625726	Veel	5	9948	4925	1711	208
36	119353	agrarisch	4949	400	1979424	Veel	5	12250	3333	524	439
37	119355	agrarisch	9052	430	3892394	Veel	3	9276	1160	237	45
38	119357	agrarisch	15506	400	6202356	Veel	5	11537	6419	1229	816
39	119359	agrarisch	9519	430	4093149	Veel	5	6626	2201	212	81
40	119360	agrarisch	77109	430	33156672	Veel	5	7041	3349	1227	511

	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1	ScoreSupermarkt	ScorePrijsPerceel	ScoreOV	ScoreGroen	ScoreFiets	ScoreOppervlak	ScoreSted	TotaalScore	% van totaal	Lengtegraad	Breedtegraad
2	0.072	-2.437	0.521	-2.499	-0.252	0.355	0.468	-3.84	66.00	98906.127	395365.473
3	0.313	FALSE	-0.585	0.078	0.024	0.355	1.639	FALSE	FALSE	179061.338	388578.863
4	0.313	FALSE	0.064	0.078	-0.252	0.355	1.639	FALSE	FALSE	181688.7	390326.301
5	0.072	-4.142	-0.585	0.078	-0.252	0.355	0.468	-4.08	65.43	174882.788	397260.978
6	0.313	-17.147	0.064	0.078	-0.252	0.355	1.639	-15.26	38.03	177742.256	389296.414
7	0.072	1.834	-0.585	2.422	-0.252	0.355	0.468	4.24	85.80	176532.146	395152.084
8	0.072	FALSE	0.521	0.078	-0.252	0.355	1.639	FALSE	FALSE	178661.358	390669.665
9	0.072	-3.569	-0.585	2.422	0.024	0.355	1.639	0.29	76.11	178973.468	399337.336
10	0.072	FALSE	-0.585	2.422	0.024	0.355	1.639	FALSE	FALSE	179389.871	391679.929
11	0.313	-8.738	0.521	2.422	-0.252	0.355	1.639	-4.05	65.49	176968.197	394167.035
12	0.313	FALSE	0.521	2.422	-0.252	0.355	1.639	FALSE	FALSE	183593.492	391029.153
13	0.313	-3.473	-0.585	2.422	-0.252	0.355	1.639	0.11	75.67	178504.333	391419.96
14	0.313	-16.934	-0.585	0.078	0.024	0.355	1.639	-15.42	37.64	182125.822	391553.47
15	0.072	FALSE	-0.585	-2.499	-0.252	0.355	0.468	FALSE	FALSE	178398.827	397954.326
16	0.313	-0.699	0.064	0.078	-0.252	0.355	1.639	1.18	78.31	181739.43	390544.315
17	0.313	3.478	-0.585	2.422	-0.252	0.355	1.639	7.06	92.70	178015.058	391861.738
18	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	179656.915	399172.566
19	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	186525.324	394762.004
20	0.313	FALSE	-0.585	2.422	0.024	0.355	0.468	FALSE	FALSE	175173.185	394100.618
21	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	178285.724	394630.791
22	0.072	FALSE	0.521	2.422	-0.252	0.355	0.468	FALSE	FALSE	176833.99	395481.281
23	0.313	-6.598	-0.585	2.422	-0.252	0.355	1.639	-3.02	68.02	178258.377	394803.547
24	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	178122.809	393612.316
25	0.313	FALSE	-0.585	2.422	-0.252	0.355	0.468	FALSE	FALSE	178487.878	396856.443
26	0.072	-6.471	-0.585	2.422	-0.252	0.355	1.639	-2.89	68.33	178443.024	391215.203
27	0.313	FALSE	-0.585	2.422	0.024	0.355	1.639	FALSE	FALSE	184577.894	394613.144
28	0.072	FALSE	-0.585	0.078	0.024	0.355	0.468	FALSE	FALSE	174137.613	396602.778
29	0.072	-1.506	0.521	2.422	-0.252	0.355	0.468	2.01	80.33	176759.007	395214.873
30	0.313	FALSE	0.064	0.078	-0.252	0.355	1.639	FALSE	FALSE	182748.815	391166.884
31	0.313	-2.060	0.521	2.422	-0.252	0.355	1.639	2.63	81.84	183931.536	394633.124
32	0.313	FALSE	-0.585	2.422	0.024	0.355	1.639	FALSE	FALSE	180425.582	395168.148
33	0.313	-8.603	0.521	2.422	-0.252	0.355	1.639	-3.92	65.82	184983.913	397656.324
34	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	176083.308	391118.602
35	0.313	-20.394	-0.585	2.422	-0.252	0.355	1.639	-16.82	34.23	184665.792	390983.443
36	0.313	-14.338	0.521	2.422	-0.252	0.355	1.639	-9.65	51.77	180950.467	399339.214
37	0.072	FALSE	0.064	2.422	-0.252	0.355	1.639	FALSE	FALSE	177018.092	397849.84
38	0.313	FALSE	-0.585	2.422	0.024	0.355	1.639	FALSE	FALSE	184893.783	394407.702
39	0.313	FALSE	0.064	2.422	-0.252	0.355	1.639	FALSE	FALSE	177453.026	394855.256
40	0.313	FALSE	-0.585	2.422	-0.252	0.355	1.639	FALSE	FALSE	178643.931	394619.858

Figure 55: Suitability document: data page

In the data page, several formulas have been used that enable the set filters and weights to work automatically. In total, eleven formulas have been applied here, all of which can be found below. These formulas have been given as case-formulas.

Land price per sqm

The land price per square meter depends on the distance of the plot towards the nearest city centre. Therefore, to successfully alter the land price automatically based on the user input, the following formula below will be used to fill in the appropriate land price per sqm:

```
CASE
WHEN 'Distance to city centre' is < 5000 THEN CELL HAS VALUE 'Set price per sqm for
        distance <5 km'
WHEN 'Distance to city centre' is >= 5000 AND 'Distance to city centre' < 10000 THEN CELL
        HAS VALUE 'Set price per sqm for distance 5-10 km'
WHEN 'Distance to city centre' is >= 10000 AND 'Distance to city centre' < 15000 THEN CELL
        HAS VALUE 'Set price per sqm for distance 10-15 km'
WHEN 'Distance to city centre' is >= 15000 AND 'Distance to city centre' < 20000 THEN CELL
        HAS VALUE 'Set price per sqm for distance 15-20 km'
WHEN 'Distance to city centre' is >= 20000 THEN CELL HAS VALUE 'Set price per sqm for
        distance > 20 km'
END
```

Total land price

The total land price of the plot is the result of the multiplication of the total area with the land price per sqm as set in the 'Analysis' worksheet.

Score - supermarket

The utility score for the distance to the nearest supermarket depends on the set criteria level weights in the 'Analysis' worksheet and the calculated distance. To update the suitability score automatically based on the user-input, the following formula was used in the 'Data' worksheet.

```
CASE
WHEN 'SupermarketAttribute' = "Not included" THEN 0
WHEN 'SupermarketAttribute' = "Included" AND 'Distance to supermarket' ≤ 400 THEN CELL
        HAS VALUE 'Set weight for walking distance to supermarket'
WHEN 'SupermarketAttribute' = "Included" AND 'Distance to supermarket' > 400 AND
        'Distance to supermarket' ≤ 1500 THEN CELL      HAS VALUE 'Set weight for cycling
        distance to supermarket'
WHEN 'SupermarketAttribute' = "Included" AND 'Distance to supermarket' > 1500 AND
        'Distance to supermarket' ≤ 'maxvalue*' THEN CELL HAS VALUE 'Set weight for
        larger cycling distance to supermarket'
ELSE CELL HAS VALUE 'FALSE'
END
```

*The maximum allowed value that a plot is located from a supermarket is by default set to 25 kilometers.

Score – price of the plot

The suitability score for the price oORthe plot depends on the calculated total land price of the plot and the set criteria weight in the 'Analysis' worksheet. To update the utility score automatically based on the user input, the following formula was used:

```
CASE
WHEN 'PriceAttribute' = "Not included" THEN 0
WHEN  'Price attribute' = "Included" AND 'Price attribute' < 400,000 THEN 0.461 + ((400,000 -
        'Price attribute' ) * 'Set weight for price' / 1000)
WHEN 'PriceAttribute' = 400,000 THEN 0.461
WHEN  'Price attribute' = "Included" AND 'Price attribute' > 400,000 THEN 0.461 - (('Price attribute'
        – 400,000) * 'Set weight for price' / 1000)
        ELSE CELL HAS VALUE 'FALSE'
END
```

Score – public transport

The suitability score for the distance to the nearest public transportation stop depends on the set criteria level weights in the 'Analysis' worksheet and the calculated distance as done in the QGIS software. To update the utility score automatically based on the user-input, the following formula was used in the 'Data' worksheet.

```
CASE
WHEN 'PublicTransportAttribute' = "Not included" THEN 0
WHEN 'PublicTransportAttribute' = "Included" AND  'Distance to PT stop' ≤ 400 THEN CELL
        HAS VALUE 'Set weight for 5-minute walking      distance to supermarket'
WHEN 'PublicTransportAttribute' = "Included" AND 'Distance to supermarket' > 400 AND
        'Distance to supermarket' ≤ 800 THEN CELL HAS VALUE 'Set weight for 10-minute
        walking distance to supermarket'
WHEN 'PublicTransportAttribute' = "Included" AND 'Distance to supermarket' > 800 AND
        'Distance to supermarket' ≤ 1200 THEN CELL      HAS VALUE 'Set weight for 15-minute
        walking distance to supermarket'
ELSE CELL HAS VALUE 'FALSE'
END
```

Score – level of greenery

The suitability score for the level of greenery in the neighborhood depends on the set criteria level weights in the 'Analysis' worksheet and the greenery value as analyzed in the QGIS software. To update the utility score automatically based on the user-input, the following formula was used.

```
CASE
WHEN 'GreeneryAttribute' = "Not included" THEN 0
WHEN 'GreeneryAttribute' = "Included" AND 'Greenery in area' = "Low" THEN CELL HAS
        VALUE 'Set weight for low level of greenery'
WHEN 'GreeneryAttribute' = "Included" AND 'Greenery in area' = "Medium" THEN CELL HAS
        VALUE 'Set weight for medium level of greenery'
WHEN 'GreeneryAttribute' = "Included" AND 'Greenery in area' = "High" THEN CELL HAS
        VALUE 'Set weight for high level of greenery'
ELSE CELL HAS VALUE "FALSE"
END
```

Score – cycling network

The suitability score for the distance to the main cycling network depends on the set criteria level weights in the 'Analysis' worksheet and the calculated distance as done in the QGIS software. To update the utility score automatically based on the user-input, the following formula was used.

```
CASE
WHEN 'CyclingAttribute' = "Not included" THEN 0
WHEN 'CyclingAttribute' = "Included" AND 'Distance to cycling network' ≤ 600 THEN CELL
        HAS VALUE 'Set weight for 2-minute cycling distance to cycling network'
WHEN 'CyclingAttribute' = "Included" AND 'Distance to cycling network' > 600 AND 'Distance
        to supermarket' ≤ 1500 THEN CELL HAS VALUE 'Set weight for 5-minute cycling
        distance to cycling network'
WHEN 'CyclingAttribute' = "Included" AND 'Distance to cycling network' > 1500 AND
        'Distance to supermarket' ≤ 3000 THEN CELL HAS VALUE 'Set weight for 10-minute
        cycling distance to cycling network'
ELSE CELL HAS VALUE 'FALSE'
END
```

Score - area

The suitability utility score for the minimum area necessary depends on the calculated area level values (in "Calculator" worksheet) and the set criteria level weights in the "Analysis" worksheet. To update the utility score automatically based on the user-input, the following formula was used.

```
CASE
WHEN 'AreaAttribute' = "Not included" THEN 0
WHEN 'AreaAttribute' = "Included" AND 'Area' < 'Minimum area*' THEN CELL HAS VALUE
        "FALSE"
WHEN 'AreaAttribute' = "Included" AND 'Area' ≥ 'Calculated area for no shared facilities' AND
        'Area' < 'Calculated area for only shared indoor facilities' THEN CELL HAS VALUE
        'Set weight for no shared facilities"
```

WHEN ‘AreaAttribute’ = “Included” AND ‘Area’ ≥ ‘Calculated area for only shared indoor facilities’ AND ‘Area’ < ‘Calculated area for only shared outdoor facilities’ THEN CELL HAS VALUE ‘Set weight for only indoor facilities’
WHEN ‘AreaAttribute’ = “Included” AND ‘Area’ ≥ ‘Calculated area for only shared outdoor facilities’ AND ‘Area’ < ‘Calculated area for both shared facilities’ THEN CELL HAS VALUE ‘Set weight for only outdoor facilities’
WHEN ‘AreaAttribute’ = “Included” AND ‘Area’ ≥ ‘Calculated area for both shared facilities’ AND ‘Area’ < ‘Maximum area**’ THEN CELL HAS VALUE “Set weight for only outdoor facilities’
ELSE CELL HAS VALUE ‘FALSE’
END

*The minimum area value is by default set to the calculated area if no shared facilities are present as calculated in on the “Calculator”-page.

**The maximum area value is by default set to 10 000 000 sqm.

Score - urbanity
The suitability score for the level of urbanity in which the plot is situated depends on the set criteria level weights in the ‘Analysis’ worksheet and the urbanity value as analyzed in the QGIS software. To update the utility score automatically based on the user input, the following formula was used in the document.

CASE
WHEN ‘UrbanityAttribute’ = “Not included” THEN 0
WHEN ‘UrbanityAttribute’ = “Included” AND ‘Urbanity’ = 1 THEN CELL HAS VALUE ‘Set weight for very highly urbanized areas’
WHEN ‘UrbanityAttribute’ = “Included” AND ‘Urbanity’ = 2 THEN CELL HAS VALUE ‘Set weight for highly urbanized areas’
WHEN ‘UrbanityAttribute’ = “Included” AND ‘Urbanity’ = 3 THEN CELL HAS VALUE ‘Set weight for moderately urbanized areas’
WHEN ‘UrbanityAttribute’ = “Included” AND ‘Urbanity’ = 4 THEN CELL HAS VALUE ‘Set weight for hardly urbanized areas’
WHEN ‘UrbanityAttribute’ = “Included” AND ‘Urbanity’ = 5 THEN CELL HAS VALUE ‘Set weight for non-urbanized areas’
ELSE CELL HAS VALUE “FALSE”
END

Total score (+ % of total)

The overall suitability score of a plot is also called the "Total suitability score" in the assessment document. The total suitability score is the result of the summation of all individual utility scores. If one of these utility scores has a value of "FALSE" then the total suitability score will also have a value "FALSE". This can be translated into the formula:

```
CASE

WHEN 'Utility Supermarket' = "FALSE" OR 'Utility Price' = "FALSE" OR 'Utility Public
        Transport' = "FALSE" OR 'Utility Level of Greenery' = "FALSE" OR 'Utility Cycling
        Network' = "FALSE" OR 'Utility Area' = "FALSE" OR 'Utility Urbanity' = "FALSE"
THEN CELL HAS VALUE "FALSE"
ELSE CELL HAS VALUE ('Utility Supermarket' + 'Utility Price' + 'Utility Public Transport'
        +'Utility Level of Greenery' + 'Utility 'Utility Cycling Network' + 'Utility Area' +
        'Utility  Urbanity')
END
```

For easier interpretation by the user, the overall suitability score is also automatically translated into the a percentage score. This score has been determined with the following formula:

```
CASE
WHEN 'Total suitability score' = "FALSE" THEN CELL HAS VALUE "FALSE
ELSE CELL HAS VALUE (('Total suitability score' – 'Lowest score possible') / ('Highest score
        possible' – 'Lowest score possible' * 100%)
END
```

Both the lowest as highest score possible are automatically calculated in the "Analysis"-page by using a summation of the 'maximum-function' and 'minimum-function' regarding the attribute level weights. Therefore, if the attribute level weights are altered, the highest- and lowest score possible are automatically updated as well.

Adjusting the weights

As can be seen in the formulas, the suitability scores are indicated as "Set weights for…". The reason for using this phrase is that the weights can change based on the user-input. Users can adjust the importance they attach to all attributes and based on their adjustments, the weights can change. An overview of the importance levels users can give to an attribute and how these influence the weights can be seen in table 42.

Table 42: Adjusting the weights

User option	How does it change the attribute level weight
Attribute is of no importance	Default weight is set to 0
Attribute considered much less important	Default weight is divided by 5
Attribute considered less important	Default weight is divided by 4
Attribute considered somewhat less important	Default weight is divided by 3
Attribute considered slightly less important	Default weight is divided by 2
Use default values	Default weight does not change
Attribute considered slightly more important	Default weight is multiplied by 2
Attribute considered somewhat more important	Default weight is multiplied by 3
Attribute considered more important	Default weight is multiplied by 4
Attribute considered much more important	Default weight is multiplied by 5

Results

The visual contents of the results page can be found here. First, in figure 56 the statistics component is showed where users are presented with both general information and the statistics. In figure 57, an example can be seen once plots were inserted into the information generator.

Statistieken

Hier kunt u zien hoeveel percelen in de provincie Noord-Brabant voldoen aan uw wensen. Daarnaast kunt u zien hoe goed de percelen scoren a.h.v. de (door u gekozen) toegepaste scorewaardes. U kunt deze informatie gebruiken om te zien wat voor effect een bepaalde wens heeft op het totaal aantal geschikte percelen.

Totaal aantal percelen	418034
Waarvan ongeschikt	99820
Waarvan geschikt	*318214*

Percentage ongeschikt	23.88%
Percentage geschikt	*76.12%*

% van MaxScore	Aantal	% van totaal
0-10%	56	0.0%
10-20%	1034	0.3%
20-30%	7274	2.3%
30-40%	12158	3.8%
40-50%	16748	5.3%
50-60%	25271	7.9%
60-70%	42634	13.4%
70-80%	79318	24.9%
80-90%	113356	35.6%
90-100%	20365	6.4%
Totaal	318214	100.0%

Figure 56: Suitability document: statistics

Informatie gevonden percelen

Mocht u in de *Geschiktheid modeller* meerdere percelen hebben gevonden die voldoen aan uw wensen, kunt u hieronder zien hoe goed ieder perceel scoort a.h.v. de (door u gekozen) variabelen. Dit doet u door de het perceel te selecteren in de *modeller* en de *FID* te kopiëren. Voor uw gemak kunt u de namen van de percelen wijzigen, bijvoorbeeld naar de straatnaam. Deze kunt u hieronder invullen in de geel gemarkeerde velden. Vervolgens kunt u zowel de totaalscore als individuele scores zien. Mocht de totaalscore een waarde hebben van *FALSE* , dan is het perceel ongeschikt a.h.v. de door u gemaakte keuzes. Waarom het perceel ongeschikt is, kunt u vervolgens zien aan de individuele scores. Mocht één van deze een *FALSE* score hebben, dan is deze locatie eigenschap de reden dat het perceel is afgekeurd. Mocht het zijn dat het perceel wordt afgekeurd door de score van de prijs van het perceel, is het belangrijk om te herinneren dat de percelen zijn gebaseerd op bestemmingsplannen. Wellicht als u slechts een kleiner deel van het perceel kunt bemachtigen (zie de kaartlaag "Kadastergrenzen" in de *modeller*) - kan het perceel alsnog geschikt verklaard worden.

	FID	TotaalScore	% van MaxScore	ScoreSupermarkt	ScorePrijsPerceel	ScoreOV	ScoreGroen	ScoreFiets	ScoreOppervlak	ScoreSted
Perceel 1	9753072	-11.463	40.9	0.051	-11.834	0.098	0.060	-0.245	0.292	0.166
Perceel 2	10881518	-11.567	40.5	0.051	-11.938	0.098	0.060	-0.245	0.292	0.166
Perceel 3	10881513	-4.309	73.2	0.051	-4.680	0.098	0.060	-0.245	0.292	0.166
Perceel 4	119314	FALSE	FALSE	-0.016	FALSE	FALSE	0.060	0.068	0.292	0.037
Perceel 5		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 6		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 7		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 8		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 9		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 10		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 11		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 12		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 13		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 14		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Perceel 15		#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Min. score ->	-20.543	0%	-0.035	-18.84	-0.284	-0.712	-0.245	-0.224	-0.203
	Max. score ->	1.64	100%	0.051	0.00	0.186	0.772	0.177	0.292	0.166

Figure 57: Suitability document: information found plots