Housing Suitability analysis of vacant office buildings.

Understanding target group preferences using a stated choice experiment

Master Thesis

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Preface

This report presents my graduation thesis for the completion of my master studies in Construction Management and Engineering at the Eindhoven university of Technology.

This research would have been impossible without the good guidance of the university. Therefore, I would like to thank my main supervisor dr.ing. P.J.H.J. van der Waerden for his enthusiasm and who was always willing to share his knowledge and give feedback when needed, and to my second supervisor Dr. Q. Han for their input and guidance in defining and writing this research.

I would like to thank my family for their understanding, constant communication and support and to my boyfriend Shai who gave me the moral support I needed through my academic year. I am fortunate to have them beside me. Without them, this would not have been possible. I would also like to thank the Mexican National Council of Science and Technology (CONACYT) for their economic aid that made possible my studies in The Netherlands.

Finally, I would like to thank everyone who helped me filling in or sharing my questionnaire to provide the data and information required to complete this thesis.

Berenisse Hernandez Quiñones

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Abstract

The demand for housing in the Netherlands is growing faster than expected and at the same time a big amount of office buildings are vacant. To avoid housing shortage in urban areas, conversion of vacant office buildings into housing is one possible solution. While adaptation and renovation of vacant buildings can prove to be a successful real estate strategy, still there is little knowledge about the opportunities and risks of building conversion. This thesis reveals how fixed attributes of a building, such as location and physical appearance, affects the housing choice preferences of different target groups and how real estate professionals can adapt the office buildings to promote different target groups to move in the converted building. In this research, a questionnaire was designed containing a Stated choice experiment (SC) to simulate the decision-making process of respondents when choosing apartments. Data was collected from different regions of the Netherlands but mostly from the North Brabant region, then it was analyzed using a Multinomial logit model (MNL) that revealed the housing preferences of different target groups. These results where later used to create a tool that could support municipalities, investors, and real estate professionals in their decision-making process by revealing what target groups are the best fit for the future housing project and how vacant office buildings can be adapted to satisfied the future tenant demands and successfully convert office buildings into residential buildings.

1. INTRODUCTION

According to numerous research (CBS, 2017a; NVM, 2016; Capital Value, 2016; ABF Research, 2015; Lennartz, Vrieselaar, & Groenewegen, 2017; Hekhuis, Nijskens, & Heeringa, 2017) the demand for housing in the Netherlands is growing faster than expected and the number of houses being added nationwide is not keeping pace with the increase in the number of households. Ongoing migration to the cities is triggering demand for urban housing. And cities like Amsterdam, The Hague, Utrecht and Rotterdam, as well as medium-size cities like Groningen and Eindhoven, are witnessing stronger house price rises than the rest of the Netherlands which are mainly attributed to scarcity pricing. This leads to the continued tightening of the housing market and bigger housing shortages (Hekhuis, Nijskens, & Heeringa, 2017). At the same time, there exists an oversupply within the office market resulting on a great number of office buildings that are vacant (NVM Bussiness, 2017). The office stock in use is fairly stable and there is no demand for expansion. New buildings are mainly built to replace the old stock. This construction of new real estate leads to oversupply and old buildings become vacant. The last Office Market report of the NVM (2017) reveals that approximately 7.75 million m² of office space were available for rent or sale at year-end 2016, that is 15.9% of total office stock in the Netherlands.

Vacancy is a problem on different levels. Economically, vacancy affects the owner of a building directly. For society, vacancy presents problems of insecurity and social uncertainty and may bring about criminality ranging from vandalism and graffiti to break-ins, illegal occupancy and fires. As such, vacancy also has indirect effects through the negative image that it gives to the surrounding area and buildings. This can lead to deterioration of the area, with rising vandalism, technical decay and devaluation of its buildings (Remøy & van der Voordt, 2006).

Knowing this, one possible effective solution to both problems is to liberate empty building stock and put it into use for housing. Conversion is the process of changing or causing something to change from one form or another. Conversion as a mean to facilitate adaptive reuse of buildings is not a new phenomenon, but it has taken place everywhere contributing to today's historical cities. One example, that resembles the problem of vacant buildings the Netherlands is suffering, is the city of Toronto. Before 1990 the city center of Toronto were mainly office districts, but after the economic recession occurring in that same year, these office buildings started to have big vacancy rates and dramatic rent reductions (Remoy & Van der Voordt , 2014). To overcome this, the city of Toronto converted the office buildings into housing use and added 9000 dwellings to the downtown area. By the year 2000 the office vacancy had fallen back to normal rates and the most suitable buildings had been converted into housing. Resulting in a successful strategy for inner city redevelopment (Remoy & Van der Voordt , 2014).

Although there are good reasons to convert vacant office buildings into housing, the number of conversions is still scarce. Real estate markets tend to be functionally separated and hence office investors do not invest in housing and vice versa and most of the time the possibilities

of conversion are not clear to office owners (Remoy, 2010). Also, big challenges involve conversions, among them are the physical and design aspects, location, financial and legal aspects.

This research aims to reveal the living preferences of identified target groups of possible tenants, considering their household composition, employment or carrier patterns, and origin revealing environmental and location preferences for living as well as the impact physical building characteristics has on housing choice and finally create a supportive tool that could help municipalities, investors, and real estate professionals to find out how vacant office buildings can be adapted to satisfied future tenant demands and successfully be converted into housing developments.

1.1 Research problem

Despite the great amount vacancy space of office buildings and the increase of demand for housing in major and medium-size cities in The Netherlands (Amsterdam, The Hague, Utrecht and Rotterdam, Groningen and Eindhoven) successful transformation of buildings depends on several factors and characteristics, physical attributes of buildings and location along with the supply and demand of the market are factors that must be considered, therefore knowing the right target group of people most likely to inhabit a renovated building might minimize the risk of conversion.

1.2 Research Question

What are the fixed attributes and flexible attributes of an office building that different target groups find more attractive and suitable for living?

To understand better the main research question 4 sub questions have been formulated:

Sub question 1: What are the main target groups of people Real Estate focuses in when planning a new housing project?

Sub question 2: What are the main preferences of the identified target groups of people regarding housing?

Sub question 3: How much value do different groups of people give to location and housing environment (neighborhood)?

Sub question 4: What factors will promote different target groups into moving into the converted building?

1.3 Research objectives

This research is conducted to understand the housing and housing location preferences inside urban areas in the Netherlands, to determine how buildings can be adapted to the demand of the housing market in order to decrease risk and increase success of transformation of office buildings into housing compounds.

1.4 Research limitations

The focus of this research is on vacant office buildings which fall into the category of candidate for conversion into housing.

The research is executed within a strict time frame and therefore it is not possible to discuss all elements that are important in the housing decision process and the housing policies of the government.

Another possible limitation is the size of the sample, which is limited to the possible number of respondents that might complete the questionnaire.

1.5 Research approach

Housing choice decisions are complex and vary depending on the life -course careers of individuals such as, labor career and family career. However not all attributes are equally important from the perspective of the different target groups, certain attributes and characteristics of the physical state of the building or location will give the potential tenant sufficient utility so they are more willing to occupy a building.

Literature review will be made in order to identify the target groups on which real state companies focuses when planning a dwelling project, once target groups are defined a questionnaire will be made using a Stated Choice (SC) approach which is a qualitative choice model used to measure the preferences of the respondents. By simulating the decision-making process via a survey, the sample group is coded and the models are estimated using Discrete Choice model (DCM) indicating the importance of the attributes and attribute levels.

The value of the coefficients of location and housing attributes can be used as a supportive tool for municipalities, investors, and real estate professionals to optimize the decision-making process used to convert a vacant office building. Further, a case study was made to validate the previous research (See Figure 1).

1.6 Research model

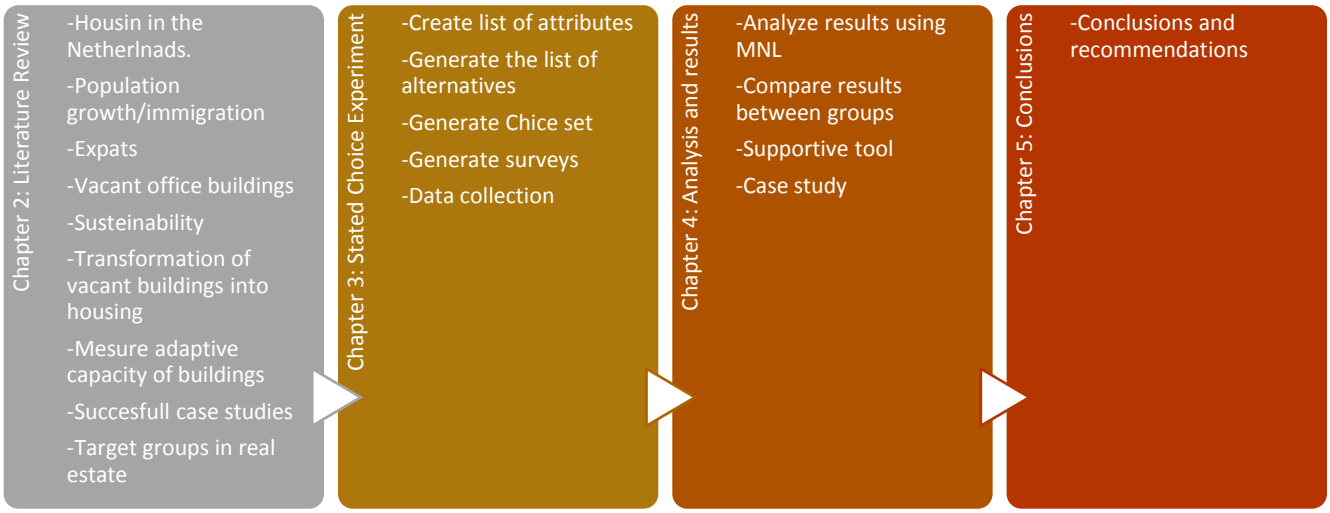


Figure 1 Roadmap by chapters

The process of this research will consist out of 6 phases presented in chapters tree to five that need to be accomplished. The steps that will be follow during this process are

1. ***Literature review***

This research starts by making a literature review of the current housing availability, what is the demand projected for future years and what is triggering that demand. The research continues describing the current vacant office space in the Netherlands, along with a description of case studies related to vacant offices and the possibility of conversion to housing.

How to measure the adaptive capacity of buildings into other possible functions during its life cycle it is also an important point, a description of the process of approving a transformation project will be presented in chapter 2.

To further explore and understand the preference of different target groups, literature review was made on looking to what current target groups Real Estate is currently focusing on, type of housing, and how is price related to location, accessibility and building characteristics.

Additionally, future trends that are expected in the housing market are described and how these trends might impact the housing choice of the different target groups.

2. ***Stated Choice experiment***

A questionnaire was made using a stated Choice (SC) experiment. The SC belongs to the conjoint analyses methods and is commonly used in multiple scientific fields e.g. marketing, healthcare and economics. A stated choice experiment is used to measure the preferences of the respondents (Kanninen, 2007). By simulating the decision-making process via a survey,

the sample groups are investigated, indicating the importance of the attributes and levels. These attributes will be divided in two main categories: fixed attributes and flexible attributes.

3. ***Online surveys***

Surveys will be made using the online survey tool of the Department of Built Environment of the University of Technology of Eindhoven, the Berg Enquete System2.2.

As a rule of thumb, (McFadden, 1984) proposes, ''sample sizes which yield less than thirty responses per alternative produce estimators which cannot be analyzed reliably by asymptotic methods.'' Therefore, 40 responses per alternative is preferred. The questionnaire was distributed for 4 weeks on social media such as Facebook and physically promoted with flyers that were left in mailboxes trough the city of Eindhoven. This data was analyzed and categorized into defined target groups using SPSS.

4. ***Analyze data using Multinomial Logit (MNL) model.***

On a stated choice experiment the MNL model is often used to analyze the choice data; mostly because it is simple to use. It allows the modeler to estimate the probabilities of choices, by including data of individual sets of choice alternatives (Kanninen, 2007).

5. ***Supportive tool and Case Study***

A supportive tool to define the target group utilities will be computed and a case study will be made in order to include validation of the model.

6. ***Conclusions and recommendations***

Conclusions and recommendations will be made following the results of the elaborated research mentioned.

1.7 Expected results

The results of this research should give an indication of the most important factors and the preferences of the different target groups defined in this research. The combination of these factors that can be considered to correctly define the more suitable target group willing to live in a specific building candidate to renovation in the urban areas.

This study might be valuable for developers, housing providers and municipalities in the Netherlands interested in the re-development of office buildings to identify the optimal combination of attributes to generate a profitable and sustainable value proposition.

2. LITERATURE REVIEW

This chapter will present an overview of the current housing demand and supply of The Netherlands, how is the population expected to grow and what factors are contributing this growth. Another interest point to analyze in this chapter is the current state of the rental market of offices in the Netherlands and how housing conversion is a sustainable way to address the high vacancy in office buildings. In this chapter, the AC method that determines the Adaptive Capacity of buildings designed by Geraedts, Hermans & Van Rijn (2014) and the Transformmeter, that measures the potential for transforming vacant office buildings into homes designed by Geraedts and Nicole de Vrijto (2004) will be described. After this, this chapter describes the success stories of the cities of Toronto and Hong Kong where transformation of office buildings to housing took place in the 90s. By the end of this chapter the target groups classification used by most real estate professionals are revealed.

2.1 Housing demand in The Netherlands

According to the CBS (Dutch Central Bureau of Statistics) the total number of inhabitants in the Netherlands is forecasted to grow by just over 1 million to a total of 18.1 million people (+6%) in the period of 2017-2040 and the percentage of household growth is expected to be around +9.2% in the same period, being the single person household the group with the largest growth increasing from 2.9 million to 3.3 million by 2025 (CBS, 2017a).

Projections made by the CBS (2017a) assume that the number of households will grow around 70,000 to 80,000 annually, excluding potential additional demand from refugees. By looking at Figure 2 the number of granted building permits reached 53,500 in 2015 and 28,700 by August 2016. Compared to the 70,000 new dwellings needed, this is by far not enough.

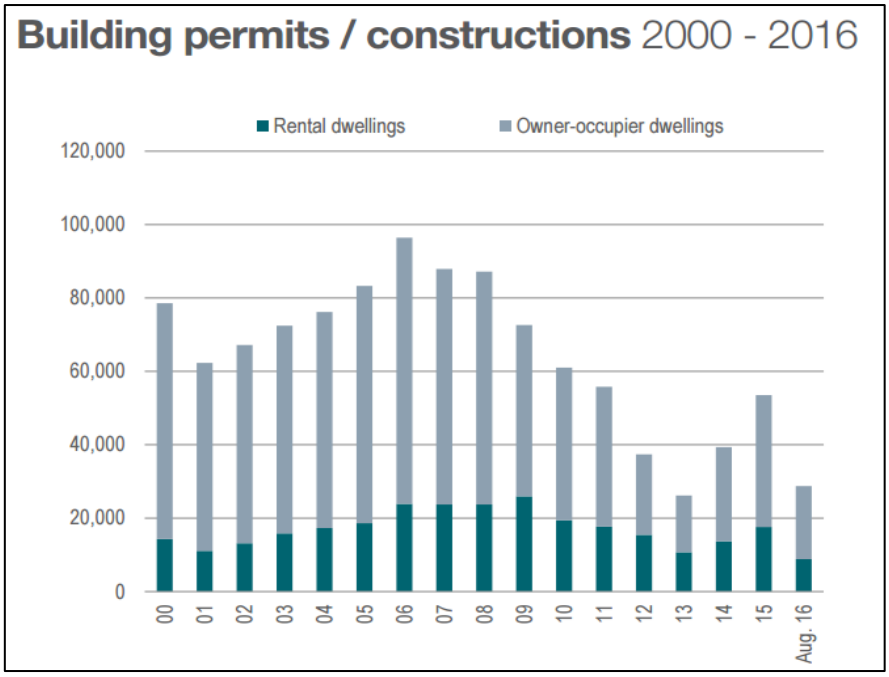


Figure 2 Building permits/construction of rental and owner occupier dwellings between 2000 and 2016 (CBS, 2017a)

In the present day, the Netherlands is already experiencing one consequence for the increase in demand of owner-occupied houses. Excluding new constructions, the value of owner-occupied houses was on average 6.7% higher in December 2016 than in December 2015; this is the most substantial price increase in 14.5 years (CBS, 2017b) and by the end of the first semester of the year 2017, it was announced by the CBS that house prices were almost 8% higher in May 2017 than it was on May 2016, (Dutch News, 2017a) which not only means it exceeds the once named "more substantial price increase in 14.5 years" but it shows a tendency for a continuous increase on the value of owner-occupied houses. This is good news for property owners but not really for first time buyers or people thinking on moving.

This is mainly caused by the high demand of housing in the market that if it continues to raise, the acquisitive power of people will decrease. Housing will become increasingly unaffordable as shortages become more acute, causing household sizes to increase as extended families are forced to live under the one roof, having an impact on family life, creating issues associated with intergenerational fairness, and a risk of homelessness (House of Lords Library , 2016).

Research (CBS, Centraal Bureau voor de statistiek, 2017a; NVM, 2016; Savills, 2016) is also predicting a shortage of dwellings; this will be most prominent in cities were the population growth is largely concentrated; specially cities like Amsterdam, Rotterdam, The Hague and Utrecht. Growth is also expected to be concentrated in Noord-Brabant, especially in larger cities like Tilburg, Eindhoven, Den Bosch and Breda (Savills, 2016).

Therefore, people who are thinking of buying a house will have to delay their home-owning plans. It was also announced that from 2018, "Mortgages cannot exceed 100% of the value of the property", meaning that buyers must have considerable savings to pay fees associated with buying a home and for renovation work (Dutch News, 2017b).

This really hits first time housing buyers, specially people on their 20s, since it has been announced that this group of people earn less than they did 10 years ago, going from 24,000 a year in 2004 to 23,000 by 2014. Although the figures date from 2014, the CBS says it has no reason to think the overall picture changed in 2015 and 2016 (Dutch News, 2017c).

Not only will first-time buyers have to wait up to five years to buy a home, but they will have to live in more expensive rental property while doing so, which will also eat into potential savings, the CPB said (Dutch News, 2017b). It means that first time buyers have to devote a high percentage of their income to saving for a deposit and paying a mortgage. Alternatively, those who cannot afford to buy a house are left to rent. But, due to supply shortages, renting is often very expensive. Also, there might be a risk of increase inter-generational wealth inequality. Homeowners see a rise in wealth and those unable to buy experience higher costs of renting. Moreover, rising house prices increases the risk of rising interest rates, which means that even with a small increase in interest rates, many homeowners who haves

stretched themselves to meet the rising prices, would find mortgage payments taking up a high percentage of their disposable income, increasing the risk of repossession.

2.2 Population growth

On 1 January2017, the population in the Netherlands stood at almost 17.1 million, i.e. 110 thousand more than on 1 January 2016. Migration contributed most to the population growth. Net migration (defined as immigration minus emigration) was + 88,000. Natural population growth (births minus deaths) was + 22,000.

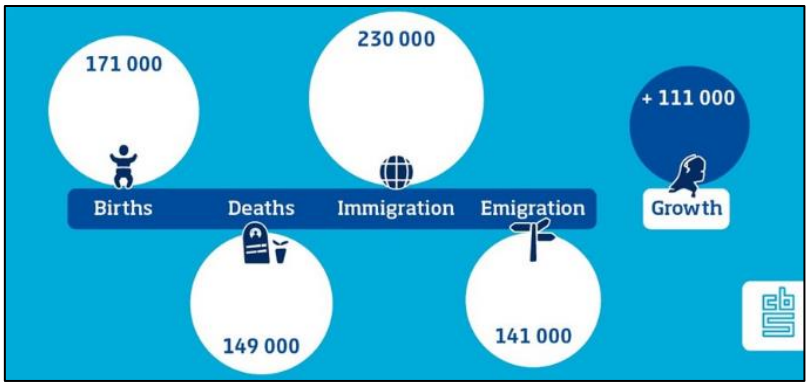


Figure 3 Graphic representation of the population growth in The Netherlands (CBS, 2017c)

Immigrants might also have different needs for housing compare to the Dutch people. A survey made by Regioplan 2005 shows that the housing requirements and housing experience of expats is not only determined by their household composition and job, but above all by their cultural background and length of stay (Boelens, 2009).

Basically, population growth is being fuelled by immigration, knowing this, municipalities should add especial attention to immigrant groups needs to better integrate them to *society.*

2.3 Immigration

On 31 December 2015, there were 855 thousand migrants in the Netherlands from other EU countries or candidate countries. This is 40 thousand up from two years previously, as reported by Statistics Netherlands (CBS) in the Migration monitor (CBS, 2017c).

The high net immigration is partly due to the growing inflow of asylum seekers. Asylum seekers with a residence permit and those who have lived in refugee centres for at least six months are allowed to register as immigrants. In 2015 the population in the Netherlands grew by approximately 21 thousand Syrians, 3 thousand Eritreans and more than 2 thousand Ethiopians. With a net migration of 9 thousand, the inflow of Polish immigrants was also substantial, though below the level of 2014. India also occurs on the top five list of largest contributors to net migration. In recent years, the number of labor migrants from India has been relatively high.

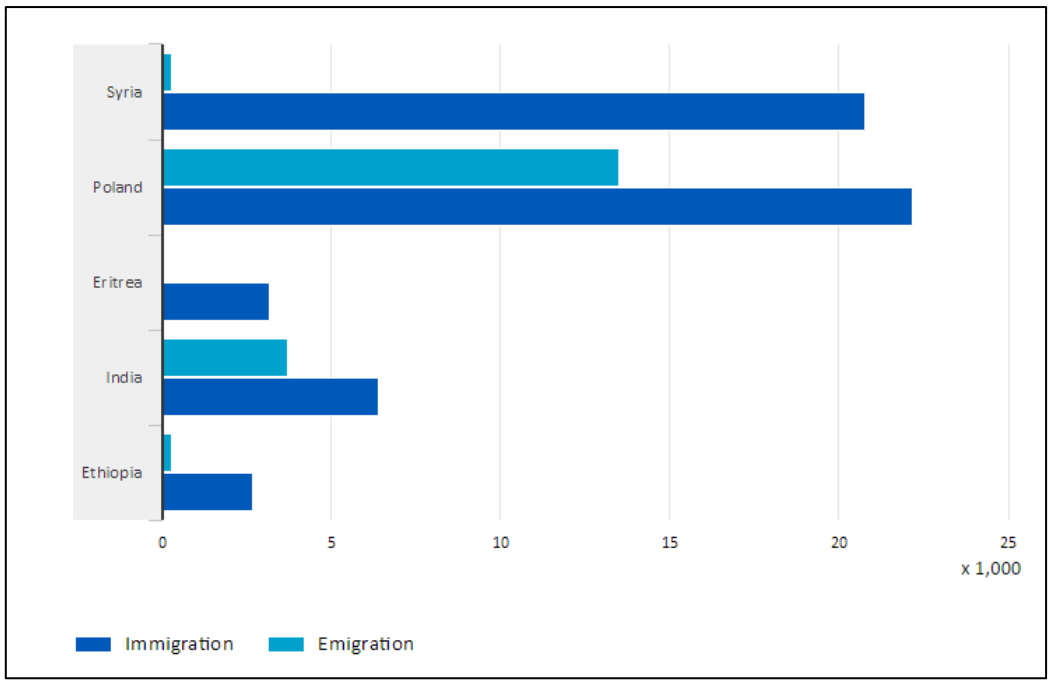


Figure 4 Top five countries with highest net migration, 2015 (CBS, 2017c)

Most Syrians who have recently registered as immigrants in the Netherlands are young: nearly 40 percent are under the age of 18, versus only 17 percent among other groups of foreign immigrants.

2.4 Expats

Expats are also internationals that come to the Netherlands but the people that fall in this category meets the following criteria:

1. An expat was born and raised in another country;
2. An expat usually earns more than a regular employee;
3. An expatriate working for an international company;
4. An expat is highly qualified;
5. An expat does not intend to settle permanently in the Netherlands;
6. An expat identifies hardly with Dutch values.

While expatriates in the current definitions come to the Netherlands to work, also students, family migrants and people with other or unregistered designs can be an expat. Only asylum migrants, au pairs and trainees are excluded from the definition. Asylum migrants can indeed be highly qualified, but have come up with a clearly different intention to the Netherlands. This also applies in principle for family migrants. But many partners of expats that come to the Netherlands will aspire to a career.

Figure 5 represents the percentage of expats living in different municipalities of The Netherlands, it clearly can be seen that the region of Randstad has a bigger percentage of expats, this might be caused by the great amount of international companies based on this area.

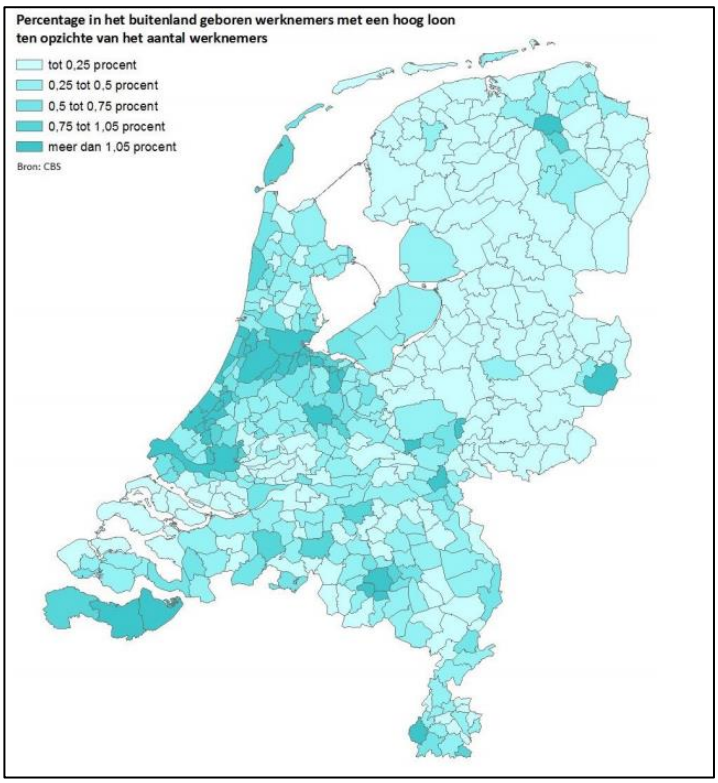


Figure 5 Percentage of expats in The Netherlands (CBS, 2017c)

According to a research made in 2016 by the website Internations.org (2017), the housing availability from the perspective of expats in several countries was listed on a top 10 and bottom 10 countries, where The Netherlands obtained the 10th place in the bottom 10 availability of housing list. being this way named by the website as the country with less housing availability. Meaning that in The Netherlands finding affordable housing for internationals is a hard task and most immigrants and expats are renting or buying what they can find instead of suiting their full needs.

Since population growth in The Netherlands is being fueled by immigrants, is important to know their characteristics, where do they come from, what are their cultural characteristics to better understand these groups needs and better integrate them to Dutch society and guide them so they can they contribute to a better development of communities.

2.5 Vacant office buildings

In the Netherlands, a big amount of office buildings are vacant. The office stock in use is fairly stable and there is no demand for expansion (NVM Bussiness, 2017). New buildings are mainly built to replace the old stock. This construction of new real estate leads to oversupply and old buildings become vacant. As can be seen in Figure 6, since 2006 office take up had a significant decrease and by 2015 in some regions in the west of the Netherlands started to recover while in the central, south and east Netherlands is still in decline, this had leads to great amount of office buildings becoming vacant in the country (Bak, 2016).

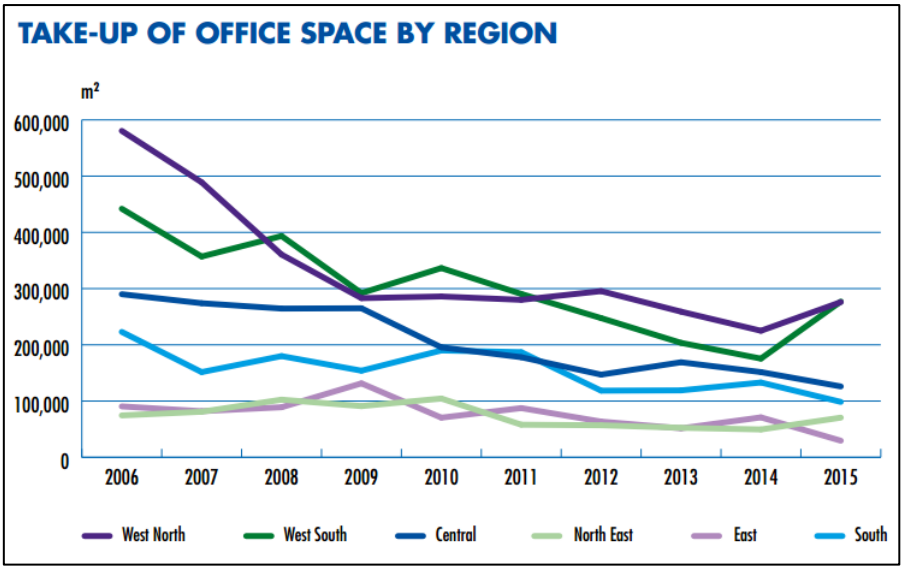


Figure 6 Take-up office space by region in The Netherlands between 2006 and August 2015 (Bak, 2016)

The last Office Market report of the NVM (2017) reveals that approximately 7.75 million m² of office space were available for rent or sale at year-end 2016, that is 15.9% of total office stock in the Netherlands. Most of these vacant office buildings are located in the centers of cities. They are well located, accessible and close to all sort of amenities. In Sloterdijk for example, a western district of Amsterdam, over 20% of the offices is vacant. In the wake of recent crises, a new approach to real estate and new ideas for use are needed to face this reality head-on.

According to the NVM Business as of March 2017, more offices were sold out and let out but also vacancy levels dropped for the second year in a row, although a better demand-supply ratio was sensed most strongly in the Randstad area, rents did not change quite significantly in the Netherlands (NVM Bussiness, 2017).

Average rents drop in The Hague, maintaining the trend of previous years. A modest decline was also experienced by the city of Rotterdam. One of the few exceptions in general presented itself in Amsterdam where rents did go up in districts like the city centre and the South Axis (+ 5% and 10% respectively) (NVM Bussiness, 2017).

Figure 7, shows the continuous decline of rent price of office space in most of the regions.

Dutch municipalities now aim at making most use of the land and space already available in cities to house more people. More and more buildings from the 70s and 80s are now transformed into apartments. In Utrecht apartments have also been built on top of the newly opened central station and are currently highly demanded.

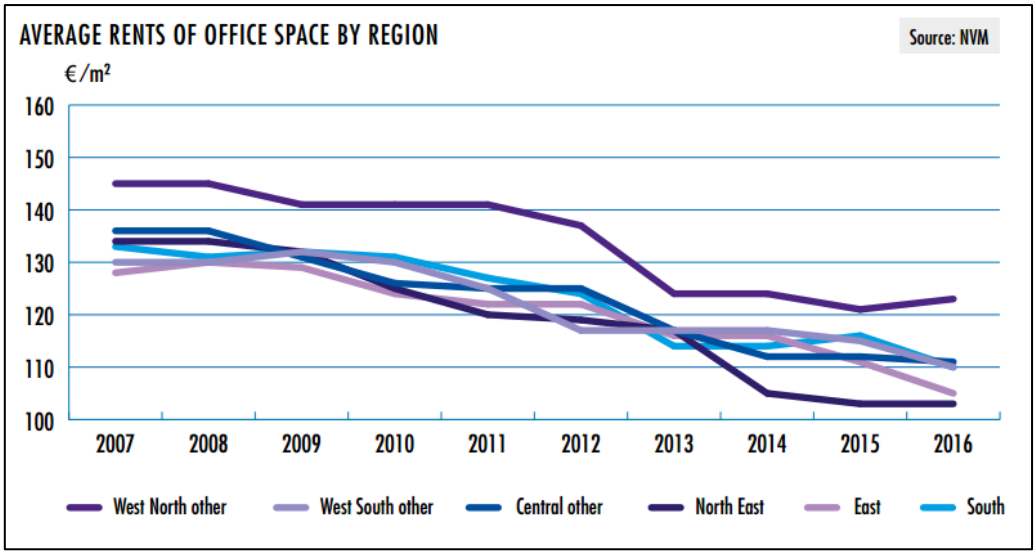


Figure 7 Average rent of office space by region (NVM Bussiness, 2017)

2.6 Sustainability

In order to deal with vacant office buildings, property owners have several possible strategies: renovate or adapt to new market segments, though smaller renovations are performed every 5 years at some point the building will require a mayor adaptation (Wilkinson & Remoy , 2011). Although in a market with high vacancy levels the risk is high since the benefits of adaptation will be less than the intervention cost. Demolition and new building creates possibilities of a good fit with current and possible future needs, although some disadvantages are that redevelopment takes time and there is income delay, and if the building is in technically good state, redevelopment is a waste of resources. Conversion is another strategy to deal with vacant buildings which sustains a beneficial and durable use of the location and the building, implies less income disruption than redevelopment and can have high social and financial benefits (Remoy, 2010).

Conversion of existing office buildings is a sustainable way of addressing vacancy. Buildings that can be reused do not have negative effect on the environmental impact. They do not have to be demolished and the old building materials do not have to be decomposed, burned down or stored under soil. Conversion of the building is also preferred over demolition and new-build because it directly saves the use of raw materials and indirectly helps the environment by saving energy and reducing the discharge of carbon dioxide (Remøy & van der Voordt, 2006).

In total, the built environment contributes 40% to global greenhouse gas (GHG). Adaptive reuse is an intrinsically sustainable option, which reduces the amount of waste going to landfill, and focuses development in the existing built environment, thereby reducing land take for new buildings and infrastructure. Furthermore, with population growth and increasing rates of urbanization, reusing existing buildings is pragmatic and allows a faster build time compared to demolition and new build. (Bullen, 2007)

The Dutch Government, several companies and branches of the construction industry started a public-private initiative in 2012 to promote and accelerate sustainable building in the Netherlands with the project called: a method to determine the Adaptive Capacity of Buildings. The adaptive capacity of a building includes all characteristics that enable it to keep its functionality during the technical life cycle in a sustainable and economic profitable way withstanding changing requirements and circumstances. With the application of transformation, the building is reused, gets a second life. This is commonly cited as the most important aspect of sustainability regarding transformation. Unfortunately, not in all cases it is possible to maintain the entire existing building. Reasons for this can be: poor condition of the existing building and the (new) requirements of the Building Decree (Swam, 2014).

Of course, the offices could also be knocked down and housing could be built on the land that is freed up. This approach has the advantage that living requirements can be optimally satisfied. Nonetheless, conversion can address the issue of durability. Piecemeal changes to the architectural structure are prevented and the need for a unique home and environment is addressed. Historical buildings can also be preserved by conversion. Other advantages are that construction can begin immediately and there is less loss of rental income. Finally, conversion can have a positive effect on the surrounding area (Geraedts & van der Voordt, 2004).

2.7 Office building transformation to housing

According to experts (Kauko, 2006), the shortage of housing locations clearly is a recurring issue in the Netherlands and to have a modern dwelling and sufficient space in the surroundings is what the consumers are most concern about.

In a research made by Kauko (2006) some attributes have been identified and assumed to have positive or negative impact on residential area attractiveness. For example, the level of public transport system, the availability of all kinds of public and private services, the sense of belonging to the community are attributes assumed to have a positive impact on residential attractiveness. Meanwhile distance to work and services, high density places and externalities caused by social disturbances, such as barking dogs or risk of being robed, have a negative impact on the residential area attractiveness. According to Kauko (2006) Some attributes have more weight than other, for example, for Dutch people living in cities, image of the city and neighborhood plays a big role when choosing for housing alternatives. Meanwhile, research reveals that in the suburbs, accessibility of locations doesn't play a potential determinant in choice, as people can travel across the region, the dwellers put a greater importance in other attributes.

At present, a large number of office buildings are vacant. The high numbers can be explained by rapid economic ageing, the economic recession and the 'hog cycle.' This repetitive cycle plays a significant role. During a period of high demand for new office premises coupled with limited availability, many new building projects are initiated. Because a considerable length of time is required for development and construction, the demand can drop considerably in

the intervening period due to conjunctional factors. As a result, the new premises may have no tenants upon completion (Geraedts & de Vrij, 2004).

Over time as the economy recovers in the country after the most recent economic recession, many of these buildings are being renovated for other purposes, such as: renovation of office spaces, redevelopment of land and housing projects.

But the conversion of a building is a risky business. If the demand of the market is not satisfied, households have diverse housing, transport and consumption needs and housing choices may vary with changes of the household composition and socio-economic factors (Buzar, Ogden, & Hall, 2005).

In comparison to 60 years ago, it can be said that the housing floor space demand has doubled, having most of the early post-war dwellings around 50 and 70 square meters and nowadays the minimum floor space of 90 to 100 square meters is already been used and required for new state (Weerdt, 2011). But also, the number of persons per household changed, in 1950 the normal household consisted on average 3.93 persons, but nowadays the average composition decreased to 2.22 persons and predictions of the CBS show that household composition will decrease to 2.09 persons by the year 2040 (CBS, Centraal Bureau voor de statistiek, 2017a). This will have a big effect on both renovation and new estate. Another aspect which is changing rapidly today is the importance of sustainable buildings, energy efficient and energy saving.

More and more people between their twenties and thirties prefer a job career over a standard family life, and in the future the need for single family dwellings such as apartments will increase (Watson, 2009). Additionally, people will move from the countryside toward urban areas, specially to the four main provinces: Noord-Holland, Zuid-Holland, Utrecht, and Flevoland. Predictions shows that for these four provinces the population will grow with 8 to 24 percent, as a result of the growing population the need for housing will also rise (Snellen & Hilbers, 2011).

Usually, building characteristics do not make conversion impossible, but can influence the financial feasibility substantially (Remoy, 2010). In the Netherlands, most vacant buildings were built between 1980 and 1995; since these buildings are not cultural-historical or have symbolic value the main driver for conversion is the future value of the location.

The appraised market value of office buildings is normally based on the potential rental income. Although structurally vacant office buildings generate no income and have no perspective of future tenancy, appraisal of structurally vacant office buildings is in most literature based on potential tenancy of the property using either the cap rate or discounted cash flow methods (Weerdt, 2011).

Conversion into housing is a way of adapting and reusing vacant office buildings. While adaptation and renovation of outdated offices can prove to be a successful real estate strategy, conversions into housing still take place only on a small scale. Some of the reasons

are uncertainty of financial feasibility and little knowledge about the opportunities and risk of building conversions (Remoy, 2010).

Moreover, there is a shortage of suitable building locations within the urban network, and the opportunity exists to bring residents back to areas from which they have disappeared, and so improve inhabitability. (Geraedts & de Vrij, 2004)

The transformation of empty office buildings into homes is only feasible when these homes fulfill a need. The supply must match the demand, with regard to location and the living environment, building characteristics and the individual homes. The type of home, size, an attractive and safe environment and a payable price are important for every target group (Geraedts & van der Voordt, 2004).

On Appendix 1 a list of the most common characteristics and significant points from demand perspective are listed.

The past years, the need for transformation projects has become greater in The Netherlands (Remoy & Van der Voordt , 2014) because of the widespread availability of offices and the shortage of housing. It is easier to persuade investors to sell offices and the political will to cooperate with transformation projects has increased.

Moreover, some buildings regulations have changed. For example, nowadays outdoor areas are no longer compulsory, this makes the division of office space simpler but might not meet the requirements of potential renters.

In order to convert an office building into a housing project, municipalities, investors and real estate professionals need to be sure of the risk and opportunities the project might face. In response, Remoy & Van der Voordt (2014) developed a table for opportunities and risk of converting office buildings into housing based on a cross-case study of 15 buildings in the Netherlands which were converted from offices to housing between 1998 and 2011. The findings show that various legal, financial, technical, functional and architectonic issues define the opportunities and risks of building conversions. These insights can be used to support decision making on how to deal with vacant office buildings.

Moreover, in another study Remoy collaborating with Geraedts, Hermans & Van Rijn (2014) develop a method to determine the Adaptive Capacity of Buildings (AC method). In the AC method, a value is given for each assessment aspect of the spatial/functional flexibility characteristics and the constructional/technical flexibility (See tables 2 and 3). In this research, the indicators with associated values for assessing the adaptive capacity for owners will be shown. There are four possible values: 1=Bad, 2=Business As Usual (BAU), 3=Better, 4=Good.

Table 1 Opportunities and risks in office building conversion to housing (Remoy & Van der Voordt , 2014)

Opportunities and risks in office building conversion to housing defined by the cross-case analysis by Remoy & Van der Voordt (2014)		
	OPPORTUNITIES	RISKS
Legal	• New function fits zoning plan. • Conversion preferred by neighbours. • Measures fit with building code requirements.	• Zoning law: Impossible to meet municipal requirements, zoning law, city policy. • Building code: Impossible to meet requirements e.g. regarding noise-level and fire precautions, the municipality is unwilling to cooperate. • Monumental act. The monumental status does not allow adaptations that are required to match future user needs.
Financial	• Low purchasing price. • Preselling implies lower financial costs. • Commercial activities in plinth.	• Development costs: slow handling of procedures (loss of income, high interests). • Vacancy: failing incomes from exploitation or sale of the apartments. • Owner not willing to sell for a reasonable price due to high book value.
Technical	• Reuse of large part of existing building, e.g. façade and construction. • Strong floors, possible to add extra weight. • Strong foundation, vertical extension possible.	• Incorrect or incomplete building structure assessment. • Poor state of the main structure/foundation (rotten concrete or wood, corroded steel). • Insufficient shafts available; construction allows no extra shafts being made. • Insufficient thermal and acoustic insulation in the floors and facades. • Insufficient daylight for housing.
Functional	• Sufficient parking space. • Existing floor plan easily adapted. • Extra “left-over space”, not available in new developments.	• Present grid does not fit with measurements required for new purposes, resulting in waste of space or costly adaptations of the technical structure. • Private outdoor space impossible.
Cultural-Historic	• Historical value, strong architectural appearance. • Positive impact on surrounding area.	• The appearance of the building does not fit with the required appearance of the new function.

the Adaptive Capacity method is a first important step in the development of instruments to formulate adaptive demands of the market and to assess adaptive supplies (Office buildings).

Table 2 Assessment of spatial/functional flexibility

Spatial /Functional Flexibility

Indicator	Assessment value	Notes
Division support -infill To which degree deals the design of building with the division between support (components with longer life cycle) and infill (components with short life cycle; easy to demount or replace)?	in % of infill 1. 10% 2. 10-30% 3.30-50% 4. > 50%	The more construction components belong to the infill domain, the more easily a building can be rearranged.
Shape of the layout How is the shape of the layout?	1. Circular or Irregular 2. - 3. Shallow and oblong, and or irregular 4. Equilateral and/ or regular	The more the layout of a building is equilateral and regular, the more easily a building can be rearranged.
Building entrance and location of elevators, stairs, cores To what extend a centralized and/or decentralized building entrance, cores, stairs, elevators, has been implemented.	1. Decentralized and separated building entrance and core. 2. Decentralized and combined entrance and core. 3. Building divided in different wings, each with a centralized and combined entrance and core. 4. Building with one centralized entrance, divided in different wings, each with a centralized and combined entrance and core.	The more a building entrance system can be used for a more independent use, the more easily a building can be rearranged.
Location Is the location of the building capable to support housing/living functions and other functions?	1. Not capable 2. capable 3. Capable for living and other function (care or shops) 4. Capable for living and other 2 functions (Care and shops)	The more a location around a building supports housing and more functions, the more easily a building can be rearranged or transformed.
Building Is the building capable to support housing /living functions and other functions?	1. Not capable 2. capable 3. Capable for living and other function (care or shops) 4. Capable for living and other 2 functions (Care and shops)	The more a building supports housing and more functions, the more easily a building can be rearranged or transformed.

Table 3 Assessment of construction/technical flexibility

Construction/Technical Flexibility

Indicator	Assessment value	Notes
Measurement System Has positioning and measurement conventions for construction components been used, for the implementation of project independent, demountable and replaceable components?	in % of implementation 1. Not implemented 2. <50 % 3. 50-90% 4. > 90%	The more project independent, demountable and replaceable construction components has been implemented, the more easily a building can be rearranged and transformed to other function.
Replaceable inner walls To what extend are inner walls easily replaceable?	1. Inner walls are not replaceable without radical/expensive construction interventions. 2. - Inner walls are not replaceable, but good destructible. 3. Inner walls are replaceable by dismantle them, and rebuild them in another location. 4. Inner walls are easily replaceable (System walls)	The more inner walls are easily to be replaced, the more easily a building can be rearranged and transformed to other function.
Measurement grid **What is the size of the measurement grid?**	1. > 3.60 m 2. Between 2.40 and 3.60m 3. Between 1.20 m and 2.4 m 4. < 1.20m	The smallest the size of the measurement grid the more easily a building can be rearranged or transformed. Horizontal grid based on 1.80m gives great opportunities for layout for living/care and large common rooms as well.
Dismountable facade to what extend can façade components be dismantled?	1. Façade components are not or hardly dismountable and have to be fully demolished and removed (<20%) 2. A small part of the façade components is dismountable (between 20% and 50%) 3. A small part of the façade components is dismountable (between 50% and 90%) 4. Most facade components are easily dismountable. (> 90%)	The more façade components are easily dismountable the more easily a building can be rearranged or transformed.
Self-supporting facade To what extend is the building façade self-supporting (load bearing)?	1. The complete façade is part of the load bearing structure of the building 2. A mayor part of the façade is part of the load bearing structure of the building (>50%) 3. A small part of the façade is part of the load bearing structure of the building (<25%) 4. The facade is fully self-supporting and is no part of the load bearing structure of the building.	The more a façade is self-supporting and is not taking part of the load bearing structure of the building, the more easily a building can be rearranged and transformed.

Transformmeter

Geraedts and Nicole de Vrijto (2004) also developed three different evaluation instruments, called “Transformmeter”. Quickscan, Feasibility model and, Checklist (which will be fully explained in this chapter) measure the potential for transforming vacant office buildings into homes based on 11 case studies in The Netherlands. These evaluation instrument are incorporated in a series of steps used when the initiative for a transformation project from vacant offices to housing appears.

1. QuickScan

Is used to make a rapid assessment of the transformation potential of an office building, if the quick scan does no lead to a veto, the office building can be investigated further.

2. Determining the target group

Based on the location, structural features of the building and the asking price, the target occupancy groups can be determined

3. Feasibility Model

Provides a picture of the financial feasibility of a transformation project. If it provides a positive outlook, the office building can be investigated further, but if it provides a negative outlook then another target group can be explored. Going back to the determining target group stage.

4. Checklist

Compiles risk inventory including possible solutions for frequently occurring problems. If positive then the building can be further investigated; if negative then the building is not suitable for transformation into housing (See appendix 3)**.**

5. Further development plans

At this stage, the checklist is used to find solutions to possible stumbling blocks. An example of this will be shown in chapter 4.5 Case study.

Figure 8 shows how the three evaluation instruments, Quick scan, Feasibility models, and Checklist are incorporated in the process of approving a transformation project when market supply of office buildings is taken as a starting point.

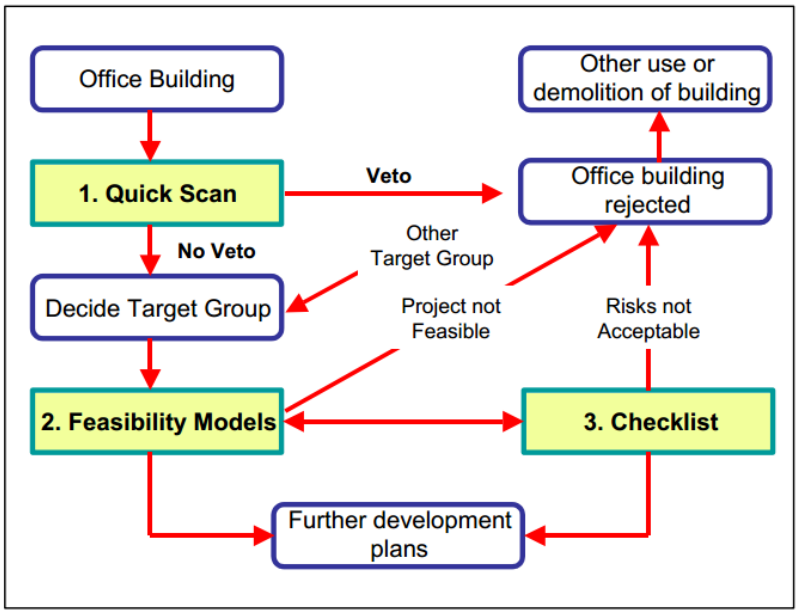


Figure 8 Implementation of three new instruments to transform office buildings (Geraedts & de Vrij, 2004)

Quick scan

The Quick scan is used to make a quick assessment of the transformation potential of an office building and a veto criteria is used. If the building receives a veto it cannot be considered further and if it doesn't receive a veto, the analyst can keep with the process of analysis of feasibility for transformation.

The Quick scan is made up of five criteria listed and described below.

1. **Internal veto criteria**

This veto criteria is determined by specific requirements regarding location and the building itself set out by the organization interested in the transformation project.

2. **Availability of enthusiastic developer**

There must be an enthusiastic developer who believes and supports the project.

3. **Housing Suitability of the office building and its location.**

The building must fulfil the requirements of the current building regulations found in the Building decree, and municipal building rules. Some examples are minimum height between floors. If the office building is located in remote industrial areas, future development of the area should be investigated. If there exists a future development plan for the area that is suitable for living, this can become an advantage since the asking price will be lower.

4. **Check willingness of the investor to sell the office building**

An attempt should be made to persuade the investor to sell. If the investor is not willing to sell the office building, then there is no point in developing further plans.

5. **If necessary, Check feasibility to change zoning plan**

An agreement should be reached with the city council as to which areas are to be considered for transformation, if the city council is not willing to change the zoning plan, then there is no point in developing further plans.

Feasibility scan using gradual criteria

Feasibility of transformation can be studied in greater detail Geraedts & van der Voordt (2007) extended the Quick scan by creating a feasibility scan where the feasibility of transformation can be studied in greater detail with reference to a number of 'gradual' criteria, that express the transformation potential of the building in question in terms of a numerical score.

The results of the feasibility scan can be used to calculate a transformation-potential score for the building in question, on the basis of which the building can be assigned to one of five transformation classes ranging from 'ideal for transformation' to 'not suitable for transformation'. The tables showing this criteria are shown in Appendix 2.

Financial Feasibility model

Financial feasibility depends on several factors, such as: cost, degree of rebuild needed, income after the project is finish and level of maintenance. If the project is not financially feasible, further plans of development must stop.

The costs are determined using index numbers for the total investment cost determined by the developing agencies.

(Geraedts & de Vrij, 2004) developed an Index cost analysis based on 11 completed transformation projects, where the acquisition costs are dependent on the asking price of the offices and income is determined based on the target occupancy group.

Table 4 gives the estimated ranges of feasible yields and investments for various target groups and types of accommodation, per dwelling unit, per m2 useful floor area (UFA) and per m2 gross floor area (GFA). An appropriate range of the ratio of UFA to GFA is also given. This is taken as 1.3 – 1.55 in all cases, since experience has shown that higher values of this ratio make it more difficult to achieve financial feasibility for the project. This data is yet not updated, therefore is used only as an estimate for now.

Table 4 Feasibility yields and feasibility investments

Dwelling type and occupant	Monthly rent	Feasible investment per unit	Feasible investment per m^2 UFA	GFA / UFA ratio	Feasible investment per m2 GFA
Student's room	160 - 220	30,000 - 45,000	930 - 1,230	1.3 - 1.55	650 - 850
Studio	220 - 320	45,000 - 65,000	1,230 - 1,830	1.3 - 1.55	850 - 1,300
2 - 3-room unit for young couple	550 - 750	110,000 - 150,000	1,620 - 1,940	1.3 - 1.55	1,100 - 1,450
4-room unit for young couple	750 - 1000	150,000 - 200,000	1,620 - 2,150	1.3 - 1.55	1,100 - 1,600
3-room unit for senior citizens	400	75.000	790 - 1,010	1.3 - 1.55	500 - 800
4 - 5-room unit for senior citizens	550 - 1,100	110,000 - 220,000	1,100 - 2,150	1.3 - 1.55	700 - 1,600

The number of homes is determined by architects and rental prices are calculated by the developer or building owner, additional revenue can be generated if commercial amenities are provided. Based on the cost and projected income, development calculations can be worked out. Using the feasibility model and new target group decision-making model, projections can be made.

Once the building cost and income are known, it is now possible to tell if a project is economically or financially viable. The Feasibility Model include financial ratios that indicate the rental price at which investment costs are recoverable.

Checklist

The checklist was made by Geraedts & de Vrij (2004) based on literature research, and case studies, where specific characteristics of a transformation project are taken into account.

This checklist can be found in Appendix 3 and includes most common problems and works as an aid when making an inventory of possible risks during the development of transformation

Projects. It is organized by Location, building characteristics subdivided into legal, economic, technical and functional elements.

Example: location level - noise

Problem: Noise levels too high at the façade. The level should be 60dB for offices and 50dB for homes (noise nuisance law).

Advice: Many inner-city locations are situated next to roads, railways and run-down industrial areas. When transforming these areas for housing, much more stringent requirements are set out, which usually means that measures will need to be taken. The preferred noise level

for housing is 50dB at the façade, but exemptions are possible for higher levels near roads and railways. If these exemptions are granted, extra measures are always necessary to restrict the noise level inside the home. This can be achieved by taking steps in the home itself, but also by erecting noise screens at the source (Geraedts & de Vrij, 2004).

2.8 Successful case studies

Toronto

One example, that resembles the problem of vacant buildings the Netherlands is suffering, is the city of Toronto. Before 1990 the city center of Toronto was characterized as office districts with very little housing in the area, but after the economic recession occurring in the early 1990s these office buildings started to have high vacancy rates and dramatic rent reductions (Remoy & Van der Voordt , 2014). To overcome this, in the city of Toronto the local government played a key role in redevelopments when it converted the vacant office buildings into housing and added 9000 dwellings to the downtown area. The drivers of conversion in Toronto included demographics and household composition with changing attitudes and housing demand, causing city centre dwelling to gain popularity. Another factor of conversion was the return in housing was estimated to be 90% higher than for commercial property (Barlow & Gann 1993 in Remoy & Van der Voordt, 2014). The Five major triggers and obstacles of conversion were found to be physical aspects, location, financial/economic, legal aspects, and the changing real estate market with growing gap between demand and supply. By the year 2000 the office vacancy had fallen back to normal rates and the most suitable buildings had been converted into housing. Resulting in a successful strategy for inner city redevelopment (Remoy & Van der Voordt , 2014).

Hong Kong

Another case of success is Hong Kong where there was a high demand for housing, but its dense structure offered little space for new developments, and changes in the urban city occur as adaptive reuse, demolition and new construction. With new construction contributing only 2% per year to the building stock, it would take Hong Kong up to 100 years for energy efficient strategies of new building construction to contribute to reduce energy use and greenhouse gas emissions according to the targets of the Hong Kong government. Sustainability is the main driver for building adaptation and conversion. Upgrading the existing building stock to improve sustainability and reduce CO_2 emissions, hence, adaptive reuse was used to reach the goals (Remoy & Van der Voordt , 2014).

Today the Dutch real estate is facing the same problems as Hong Kong and Toronto, obsolete office buildings, sustainability aims and a tight housing market are the most important conversion drivers and conversion of structural vacant office into housing could contribute to increase and broaden the housing supply and at the same time create possible new use for obsolete office buildings.

2.9 Target groups

To determine whether an unoccupied office building is suitable for transformation to residential accommodation for one or more target groups. First of all, target groups must be defined. Each of these target groups might have specific living requirements. Since studies reveal that large single family housing tend to be preferred most by families with children, while young adults and seniors tend to prefer smaller homes and more accessible multi-modal locations.

Geraedts & de Vrij (2004) and McCarthy (1976) define some target groups interested in inner-city transformation projects defined by their life cycle stage. In this research, will be focused in the following groups.

Nest leaver

Young people above 18 years old who are leaving their homes for the first time to live by themselves. Can be classified into:

- Starters, young single students. Low income singles, looking for shared accommodation in urban environments with plenty of amenities.
- Starters, semi-independent students. Household headed by single adult, young, low income singles looking for independent accommodation.

Young Professionals

People Just entering the labour force. They are probably seeking the “starter home”. To then work their way up to the property ladder as their family, income and needs grow. Can be classified into:

- Young single head, no children. Household headed by single adult, young professionals, looking for accommodation in urban or suburban environments. under 46 years old, no members under 18 years old.
- Young, two incomes. Young couples with two incomes, looking for accommodation in urban or suburban environments.

Parents with children

People with growing families looking to upsize their homes. Can be classified into:

- Young couple with children. Household headed by a couple, under 46 years old, at least one other member under 18 years old.
- Older couple, with children. Household headed by married couple, one of the members above 46 years old, at least one other member under 18 years old.

Empty Nester

This group is usually looking to downsize their homes since their children have grown up and left home.

- Older couple, no children. Household headed by married couple, one of the members above 46 years old. No other member under 18 years old.
- Older single head, no children. Household headed by single person (man or woman) above 46 years old. No other member under 18 years old.
- Senior citizens 55+; low modal income. Safe dwelling environment, close to daily amenities and public transport.
- Senior citizens 55+; above modal income. Safe dwelling environment, big space, close to daily amenities and accessible by car.

Nowadays, preferences of target groups have changed, for example, young people, who are people born in the late 80s and 90s, known to be technology savvy, are more inclined towards energy-efficient homes that can save them money in heating and cooling costs. And they are willing to trade size for high quality homes. Open floor plans, with kitchens that open into the living room and a large outdoor living space. Some may not want dedicated spaces, like a formal dining room. Young professionals want the flexibility to turn a dining room into a study, or vice versa (Takahashi, 2015).

An article from the New Jersey Business Magazine (2016) states that "Millennials will trade square footage in their apartments, particularly if there is a good balance of living and working space like a den or office, but expect higher-end amenities."

This research will be used to analyse if this statement also applies for young people of the Netherlands, to see if they are willing to trade space for amenities such as location and apartment buildings that include retrofit lobbies, communal rooms, build fitness facilities communal green areas etc.

Internationals, new potential target

Expats is one target group in which some real estate agents are starting to look after. Very few information can be found about the housing preferences of this group (Jeroen & Verkooijen, 2015) (Snellen & Hilbers, 2011) knowing that they only will be renting in the Netherlands for a short period of time. Expats aren't particularly bothered about paying too much rent for the apartments they moved into.

By knowing the target groups and their preferences, rental or selling price and an idealized layout are drawn up for these target groups. The target groups are coupled with idealized layouts, which are based on specific living requirements. The number of homes for a transformed building is determined in this way, as are the total rent and/or sales income. This calculation only includes income from housing. Additional revenue can be generated, for example, with the provision of commercial amenities.

3. DISCRETE CHOICE EXPERIMENT

In order to adapt vacant office buildings for housing, different studies have to be made, for example permits regarding the Dutch Building Decree and marketing studies analyzing the surrounding areas as well as the potential tenant needs. This chapter introduces the research method Discrete Choice Experiment (DCE) used to measure the preferences of potential tenants and its application within this research.

When the consumer first becomes aware of a need and/or a problem to be solved, then continues to search for information in which he or she learns about products that can satisfy the need or solve the problem. When the consumer becomes sufficiently informed, the consumer is then able to evaluate and compare alternatives and forms a decision rule (Utility function) which involves valuating and trading off product attributes that matter in the decision. Given a set of attributes each product alternative possesses, the consumer develops a preference ordering of products, and depending upon constrains or considerations makes a decision about which alternative to purchase or not purchase at all.

3.1 Stated Choice Experiment

Two types of choice data have emerged as the primary sources of choice response. These are known as revealed preference (RP) and stated preference (SP) or stated choice (SC) data. RP data refer to situations where the choice is made in real market situations; in contrast SP data refer to situations where a choice is made by considering hypothetical situation (Hensher, Rose, & Greene, 2015).

SC data are especially useful when considering the choice among existing and new alternatives of products and services to reveal their preferences and hence values(utilities) by their choice.

Unlike most survey data, where information on both the dependent and explanatory variables is captured directly from respondents, SC data is unique in that typically only the choice response variable is provided by the respondent (Hensher, Rose, & Greene, 2005). It provides subjects with different alternatives simultaneously and simply asks them to identify the most preferred option in each choice set.

The primary variables of interest, consisting of attributes and their associated levels, are designed in advance and presented to the respondent in the form of competing alternatives in SC studies.

When conducting a stated choice experiment, in order to evaluate the utility of several attributes, the following steps shown in Figure 9 are performed.

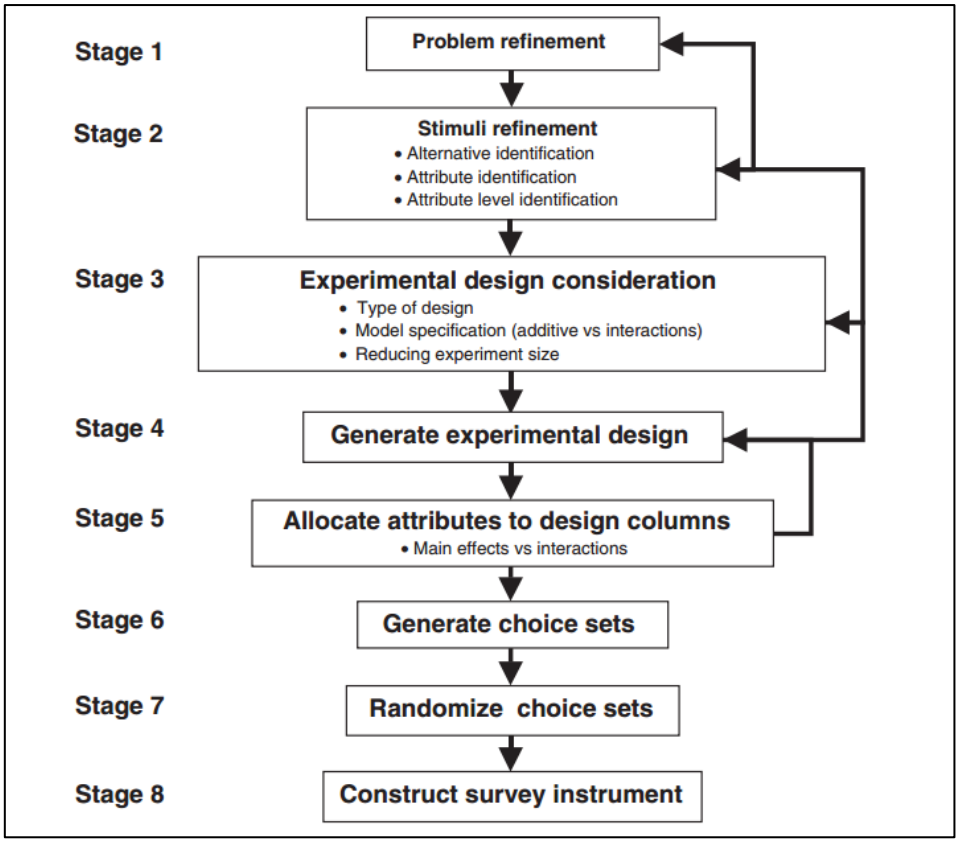


Figure 9 Experimental design process (Hensher, Rose, & Greene, 2015)

3.2 Problem Refinement. Housing choice

The first stage in an analyst's journey towards deriving an SP choice experiment is to refine their understanding of the problem being studied. The analyst begins by asking the question "Why is this research being undertaken?" By defining the problem clearly from the outset, the questions that "need" to be asked may be determined, as well as irrelevant questions that can be avoided (Hensher, Rose, & Greene, 2015).

The aim of this Discrete Choice Experiment is understanding the preferences of future tenants regarding possible housing units realized by transforming vacant office buildings.

3.3 Stimuli refinement

This stage is divided in 2 sections.

The first section of the stimuli refinement consists in defining the universal but finite list of alternatives available to decision makers. For this study literature review has been done identifying the different housing options in the market available in the Netherlands through websites such as: government.nl/topics/housing, funda.com, pararious.com, and directwonen.nl.

In this section, we are able to find, townhouses, apartment houses, semi-detached houses and single-family house, with different sizes, prices (rental or sell), and characteristics.

Figure 10 Example of different types of dwelling most commonly found in The Netherlands

The second section involves the culling of alternatives from the list. Leaving the ones that apply better to office building conversion. One way of reducing the alternatives is to exclude "insignificant" alternatives, such as, single family houses, dwelling located in low density places etc. since some of these alternatives cannot be applied to office building conversion. The problem here is that the analyst is required to make the somewhat subjective decision as to what alternatives are to be considered insignificant and therefore removed from the study. There are several attributes that remain constant through the entire questionnaire. This is what is called scenario.

When making an investment for the dwelling market, interest groups (investors, real estate professionals, corporations etc.) need to define the purpose of the dwelling to build. Will the dwelling be sold or rented? if rented will it be rent-controlled or non-rent controlled? Where is the development going to occur? and what type of dwelling is going to be develop?

For the purposes of this research, the following alternatives marked in yellow in Table 5 Market attributes will be chosen to set up the scenario.

Table 5 Market attributes

Attributes		Explanation
1. Market	Rental market	Housing units available for rent
	Buyer's Market	
2. Location	High density cities	Highly dense cities such as: Amsterdam, Rotterdam, Den Haag, Utrecht, Eindhoven, Tilburg etc.
	Low density cities	
	Towns	
3. Housing type	Multi-family housing	Multiple separate housing units for residential inhabitants are contained within one building.
	Single-family housing	
4.Controlled housing	Rent-controlled housing	The non-rent controlled sector encompasses all rental property with a base rental price higher than € to €710.68 euros per month (2016) and is owned by both housing corporations and private landlords.
	Non-rent controlled housing	

1. Market: Rental

In this research, the focus is on the rental market and not on buyer's market. This way is easier to include target groups such as students, who are mostly not yet available to buy a property, as well as internationals living in The Netherlands temporarily.

Around half the country's housing stock is rental properties, but much of that is restricted to low income households and the other part in controlled by private landlords.

- Rent controlled housing (Sociale huurwoning). Only available for households with an income less than €35,739 per year. There is usually long waiting list for rent-controlled housing, especially in cities. The rent controlled covers housing up to €710.68 euros per month (2016) of base rent and much of these rent-controlled properties are owned by housing associations.
- Non-rent Controlled housing (Vrije sector). The non-rent controlled sector encompasses all rental property with a base rental prices higher than € 710.68 euros a month (2016) and is owned by both housing corporations and private landlords.

2. Location

Most transformation projects around the wold mostly occur in high density urban areas, where the demand for housing is high. According to the CBS the 10 most highly dense cities in the Netherlands are: Amsterdam, Rotterdam, Den Haag, Utrecht, Eindhoven, Tilburg, Groningen, Breda, Nijmegen and Almere (CBS, Centraal Bureau voor de statistiek, 2017a).

3. Multi-family housing

Multi-family housing are multiple separate housing units for residential inhabitants contained within one building, this is the perfect case for transformation for vacant office buildings to housing.

4. Non-rent Controlled housing

The rent market in the Netherlands is divided in two: rent controlled housing and non-rent controlled housing, since for rent controlled housing there is a long waiting list, making it less reachable in this research we will focus on the non-rent controlled sector encompasses all rental property costing more than € 699.48 a month (January 2014) and is owned by both housing corporations and private property owners.

3.4 Attribute identification and attribute level.

Having identified the scenario to be studied, attributes and attribute levels must be now determined. When tenants, future users, are searching for a new residence, there are certain features that they are looking for. These characteristics depend on the targeted group, but they always concern location, building characteristics and price.

The attributes in this study are derived from a literature study made by (Geraedts & van der Voordt , 2007) shown in Table 6 Significant points from demand perspective . The extended list of attributes generated based on these points can be found in Appendix 4.

Table 6 Significant points from demand perspective (Geraedts & van der Voordt , 2007)

SIGNIFICANT POINTS FROM DEMAND PERSPECTIVE	
Location (Living environment) 1. *Representative/Character* **a.** Nature of the building **b.** Social image **c.** Vitality **d.** Greenness 2. *Facilities* **a.** Shops **b.** Bars, restaurants, etc. **c.** Schools **d.** Bank/Post office **e.** Medical facilities **f.** Recreational facilities 3. *Accessibility by public transport* **a.** Distance to public transport **a.1** Frequency and times **b.** Distance to tram or metro **b.1** Frequency and times **c.** Distance to train station **c.1** Frequency and times 4. *Accessibility by car* **a.** Distance to motorway **b.** Traffic though flow **c.** Parking opportunities	**Building (Dwellings)** 1. *Type of house* 2. *Entrance* 3. *Size of home* a. Number of rooms b. Living room c. Kitchen d. Bedrooms e. Sanitary space f. Storage space 4. *Layout of the home* 5. *Level of facilities* 6. *Outside space* 7. *View out and view in* 8. *Environmental factor* a. Heating b. Ventilation c. Noise d. Sun and daylight e. Energy usage f. Material usage 9. *General conditions* a. Accessibility b. Safety c. Alterability d. Adequate management 10. *Costs* a. Purchase or renting price b. Additional costs

This list was later reduced to only key attributes that are important to the potential tenants, this information is based on individual interviews, literature research and opinions from professors at the Eindhoven University of Technology. These modifications are mostly related

to the rule of thumb that the most appropriate number of attributes for modelling is between 7 and 10 attributes (Hensher, Rose, & Greene, 2015).

These attributes where divided in two categories, Fixed attributes: which are those that cannot be changed through renovation, and those that can be implemented in the dwelling design. Location is one of those attributes that cannot be change when conducting a transformation project, if the location of the building is in a highly desirable area, people are much willing to compromise on other amenities if they are in the location that is desirable to them, for example, people are willing to pay higher prices in order to live in city centres, close to transportation, shopping, food or entertainment (Bryson, 1997). Therefore, in this research location attributes such as distance to public transport, city centre and walkable distance to services such as supermarkets schools, restaurants and parks will be evaluated.

Some studies that have provided models of the relationship between residence and workplace (van Ommeren, 1999, in William, Huang & Wither (2003). Asking if households minimize commuting distances when they change residence and the nature of the link between residence and workplace for one-worker and two-worker households. In order to integrate other possible target groups in this study the location of main activity of different target groups was integrated, such as, workplace and study institutions in the case for students.

Several studies have been conducted about the influence of housing characteristics and the influence they have on choice. Housing attributes range from intrinsic housing attributes such as cost and size to extrinsic attributes such as exterior design and other location factors. While other functional attributes such as housing type, and outdoor space, are also mentioned often (Geraedts & van der Voordt, 2004; Douglas, 2006; Kauko, 2006; Opokua & Abdul-Muhminb, 2010).

In addition to these attributes, it would be interesting to see the influence of physical appearance and aspects of the building, such as façade and building height (Opokua & Abdul-Muhminb, 2010).

The resulting attributes that are used within the questionnaire are presented in Table 7 attributes and attributes levels also found in Appendix 5 which also includes the levels assigned to each attribute as part of the experimental design process. These are presented by numbers and labels; number labels are meant to have a meaning for the analyst but not for the decision maker being surveyed meanwhile, attribute labels are assigned to each attribute level that will provide meaning to the decision maker.

Table 7 attributes and attributes levels

	Attribute	Level	Label	Description
New or can be changed				
1	Rent	0	a. 1100 euros	Base rent price, Service costs not included.
		1	b. 900 euros	
		2	c. 700 euros	
2	Type of Apartment	0	a. Appartment with 1 bedroom	Apartment with 1 bedroom or 2 bedrooms. Studio includes: Bedroom, kitchen and living room in the same space (no divisions).
		1	b. Appartment with 2 bedrooms	
		2	c. Studio appartment	
3	Building use	0	a. Serviced Appartment (building including fitness center and/or	**Mixed-use building:** Blends residential and comercial uses. (Ex. Appartment building with Supermarket, or small business on ground level). **Serviced Apartment:** Provides amenities like: fitness center and/or recreational room (room used for a variety of purposes, such as games room or hosting reunions). **Residential Only:** A building used for only for dwelling.
		1	b. Mixed-use building	
		2	c. Residential only	
4	Outdoor space	0	a. Balcony	Type of outdoor space.
		1	b. Roof terrace	
		2	c. No outdoor space	
5	Walkability in the Neighborhood	0	a. High	A Neighborhood is considerate walkable when is capable of being traveled or covered by walking. and it can be measured by the distance radious of services such as: supermarkets, basic schools, parks and restaurants. The walkability level of a Neighborhood is considered: **High:** When services are located within 800m radious. **Medium:** When services are located between 800m and 1.5 km radious.
		1	b. Medium	
		2	c. Low	
Fixed attributes				
6	Distance to city centre	0	a. Within city centrum	Location of building in relation with city centre.
		1	c. 7 min by bike	
		2	c. 15 min by bike	
7	Distance to main activity	0	a. 6 min by bike	Distance to main activity point: such as worklocation or study institution.
		1	b. 12 min by bike	
		2	c. 18 min by bike	
8	Distance to public transport	0	a. 3 min walking	Distance to nearest public transport (Ex. bus stop, train station, tram if applicable).
		1	b. 5 min walking	
		2	c. 7 min walking	
9	Façade	0	a. Heritage building	**Heritage building:** a building of historic, aesthetic, architectural or cultural significance. **Conventional building:** A building that its architectural style resembles any other building in the area, nothing special. **Modern building**: A building with a modern architectural style.
		1	b. Modern building	
		2	c. Conventional building facade	
10	Height	0	a. High rise Building	**A low-rise** is a building that is only a few stories tall, max 4 stories high. **Mid-rise** is a building between 4 and 7 stories. **High rise** Building usually is higher than 23 m or about 8 or more stories.
		1	b. Mid-rise Building	
		2	c. Low rise Building	

1. Rent

The price is always important in product selection. The housing price is sticky correlated with the location, partly due to land prices. Prices are based on market values based on current market supply published on websites such as: Funda.com, Pararius.com, Onlyexpart.nl, and Housingxl.nl, and the offer found from housing corporations such as Holland2stay and Camelot.

Since rental price is directly related to space it is possible to find studios, one-bedroom apartments and two-bedroom apartments between 700 and 1100 euros, including base rent price, service cost and building maintenance fees.

The levels that were found are:

0. 700 euros base rent per month
1. 900 euros base rent per month
2. 1100 euros base rent per month

2. Type of apartment

Several types of rental properties can be found, the most common rental property in the Netherlands are apartments studios and multi bedrooms apartments. Studios are dwellings consisting of a large single main room which acts as the living room, dining room and bedroom combined and usually also includes kitchen facilities, with a separate smaller bathroom.

Apartments are individual housing units in a multi-family building. These can range from a single one-bedroom apartment all the way up to four-bedroom apartment home. Aside from the bedrooms, these units come complete with separate living rooms. In this research, we will focus in the one and two-bedroom apartments therefore choosing the following levels:

0. Apartment with 1 bedroom
1. Apartment with 2 bedrooms
2. Studio

3. Building use

Normally, apartment buildings are more common in suburban and urban areas, where the land availability is limited and the demand for housing is high. It is also very common nowadays to find apartment buildings which blends residential and commercial uses, especially in the heart of urban areas where these buildings help conserve valuable and resources, but also brighten communities and present opportunities for building efficiency, while some other buildings remain as residential use only. For example, in city centers in the Netherlands is very common to find apartments above small business. Although lately there is a trend in real estate of creating “Serviced apartments” where residents can enjoy additional facilities such as fitness facilities, and/or recreational room (room used for a variety of purposes, such as games room or hosting reunions) or even swimming pools (Soon, Jung, & Suk, 2002). For this research, we will discard the swimming pool option due to the high cost this implies due to the weather conditions in the Netherlands.

0. Serviced apartment (including building including fitness center and/or recreational room)
1. Mixed-use building
2. Residential only

4. Outdoor space

The design of an outdoor space might have a positive impact on residents and neighbors. Some apartment buildings might not have an outdoor space, while some others might. Outdoor space may be public (accessible to members of the general public), communal (shared by residents) or private (associated with a single apartment for the exclusive use of

the occupants). In this research, the focus is on apartments with private outdoor space such as private balconies, communal outdoor space such as roof terraces, and no outdoor space. Creating the following levels:

0. Balcony
1. Roof terrace
2. No outdoor space

5. Walkability

Walkability is an important concept for urban planners because it reflects the possibilities for activities, such as working or shopping, available to residents of a neighborhood. The level of walkability reflects how capable is an area of being traveled or covered by walking. It can be measured by the distance radius of services such as: supermarkets, basic schools, parks and restaurants. The walkability level of a Neighborhood is considered: High: When services are located within 800m radius, Medium: When services are located between 800m and 1.5 km radius. Low: When services are located at more than 1.5 km radius. Therefore, creating the following levels for this study.

0. High walkability
1. Medium walkability
2. Low walkability

6. Distance to city Centre

The distance to city centre is important when considering various housing alternatives, being apartments close by the city centre are the ones with most demand due to the closeness to different services and work or leisure activities. The bicycle is one of the most common forms of transportation in the Netherlands and is easier for people to relate to the time it takes to reach a certain location using a bicycle (European, 2014). Consequently, the following levels regarding this attribute are created in time it takes to reach the city centre by bike:

0. Within city centre
1. 7 min by bike
2. 15 min by bike

7. Distance to place of main activity

“Main activity" is a task that a person realizes more frequently than any other on a daily basis. Some examples of Main Activities are: studying, working, house-care, sports, etc. Most of these main activities take place in places such as offices, study institutions, industrial locations, health institutions, etc. In this research, the attribute levels are defined by the time it takes to reach the place where people’s main activity is done in a bicycle, being this one of the most common type of transportation in the Netherlands (European, 2014).

0. 6 minutes by bike
1. 12 min by bike
2. 18 min by bike

8. Distance to public transport stop

Public transport is important for social inclusion, for providing access to participation in life opportunities and to reach activities and services such as work, education, health, shopping and social-recreational activities (Currie, Stanley, & Stanley, 2013) In this research, we will define the distance to public transport as the time it takes to walk and reach a bus stop, train station or tram station if applicable.

0. 3 minutes walking
1. 5 min walking
2. 7 min walking

9. Façade

An apartment building’s façade is closely linked to its overall image and environmental performance. But not much information can be found about the endogenous features, such as attractive facades, and he effect those features have on rent for the building themselves (Bourassa, Hoesli, & Sun, 2004). A research made by Wilkinson & Remoy (2011), compares the Dutch and the Australian office market, shows that, in adaptation projects, changing the appearance of the building has a relatively high added value compared to other interventions. This might also be the case for apartment buildings, therefore it will also be included in the research.

Based on the information found, the need to calculate how the building façade influences in apartment choice is created to find out if indeed renovating the façade will affect the decision process, therefore the influenced of the following type of facades will be analyzed: heritage building: a building of historic, aesthetic, architectural or cultural significance, conventional building: A building that its architectural style resembles any other building in the area, nothing special, and modern building: A building with a modern architectural style.

0. Heritage building
1. Modern building
2. Conventional building façade

Figure 11 Examples of building facades

10. Height

Building height is another factor by which there is not enough information about the effects it has in rental price for apartments but is linked to the overall image of the building and environmental performance. The attribute that is directly linked to building height is the view and in one study (Benson, Hansen, Schwartz, & Smersh, 1998) determined that the willingness to pay for a view is quite high. Since is hard to determine the type and quality of the view in a building, this research will focus on the high of the building, dividing this attribute in: buildings with only a few stories tall: max 4 stories high as low-rise buildings, buildings between 4 and 7 stories as mid-rise buildings and high-rise buildings that according to European standards is a building higher than 23m or about 8 or more stories.

0. High rise building (8 or more stories or higher than 23 meters)
1. Mid-rise building (between 4 and 7 stories)
2. Low-rise building (maximum 4 stories high)

3.5 Experimental design considerations

Rather than have decision makers rate or rank a treatment combination, we may now have them choose which of the alternatives they would select given the levels each alternative assumes. For this a label experiment or un-label experiment can be use. When an alternative has a label such as Car vs train it is called labeled experiment but when a title is neglected, this is called unlabeled experiment.

In this case an unlabeled experiment will be used, this way, the title does not convey any information to the decision maker other than the alternatives. The reason of creating an unlabeled experiment is that it does not require the identification and use of all alternatives within the universal set of alternatives and due to the non-existence of the dwellings described in each one of the alternatives this is the best type of experiment for this research.

Having identified the alternatives, attributes, the number of attribute levels, and the attribute-level labels, the analyst must now make decisions as to the design to be used.

The first choice is based on the preference for a full factorial design or a fractional factorial design. A full factorial design estimates all the main effects and the interaction effects, covers all possible combinations, L^A combinations, where L are the number of attribute levels and A the number of attributes. In this research, this results in: $L^A = 3\text{^}10 = 59049$ treatment combinations. Rather than use all 59049 possible combinations, it is possible to use only a fraction of the treatment combinations. This kind of designs are called fractional factorial designs. In this case the number of random treatment combinations must be selected from the total number of treatment combinations. However, random selection is likely to produce statistically inefficient or sub-optimal design. What is required is a scientific method that may be used to select the optimal treatment combination to use.

For this research, the amount of minimum treatment combinations necessary for the fractional factorial design is based on the Hahn and Shapiro Design Index (1966) (Hahn & Shapiro , 1966), resulting in 27 treatment combinations.

3.6 Generating experimental design

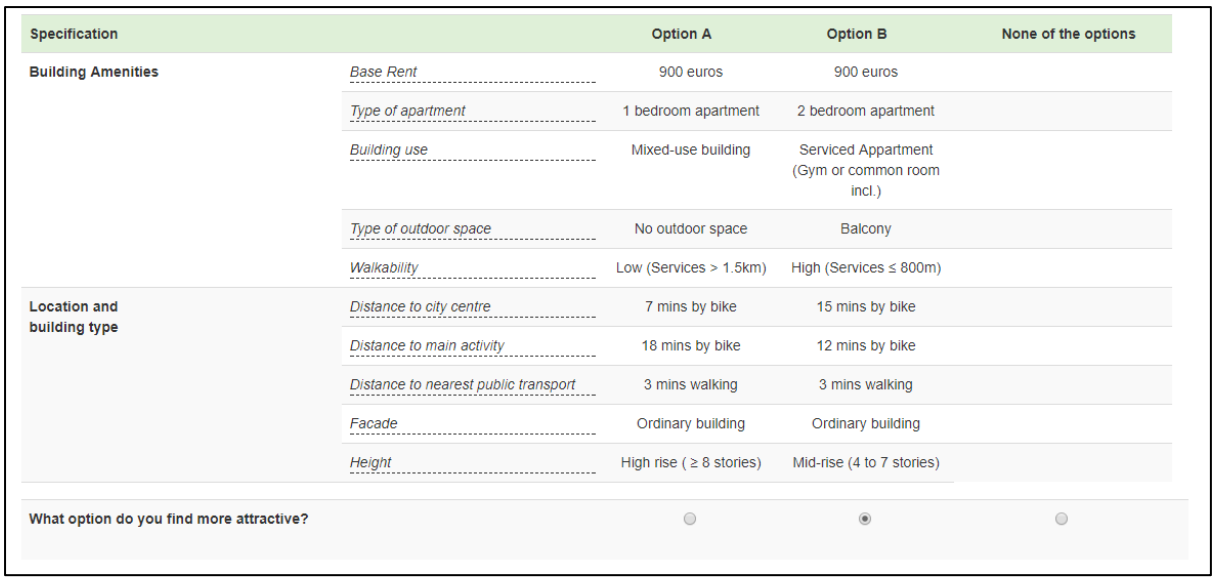
The 27 treatment combinations are sufficient to create an orthogonal uncorrelated design, Hahn & Shapiro (1966) have created a design matrix that applies to this experiment based on the number of attributes (10) and levels (3), shown in Table 8 Design Matrix for 27 combinations the numbers 0, 1, and 2 refer to the attribute level that applies to each profile number of each attribute.

Table 8 Design Matrix for 27 combinations (Hahn & Shapiro , 1966)

Profile number	Price	Bedrooms	Use	Outdoor	Walkability	Centrum	DistMainAct	DistPT	Façade	Height
1	0	0	0	0	0	0	0	0	0	0
2	0	0	1	1	2	1	1	2	1	2
3	0	0	2	2	1	2	2	1	2	1
4	0	1	0	0	0	1	1	1	2	2
5	0	1	1	1	2	2	2	0	0	1
6	0	1	2	2	1	0	0	2	1	0
7	0	2	0	0	0	2	2	2	1	1
8	0	2	1	1	2	0	0	1	2	0
9	0	2	2	2	1	1	1	0	0	2
10	1	0	0	1	1	0	1	1	1	1
11	1	0	1	2	0	1	2	0	2	0
12	1	0	2	0	2	2	0	2	0	2
13	1	1	0	1	1	1	2	2	0	0
14	1	1	1	2	0	2	0	1	1	2
15	1	1	2	0	2	0	1	0	2	1
16	1	2	0	1	1	2	0	0	2	2
17	1	2	1	2	0	0	1	2	0	1
18	1	2	2	0	2	1	2	1	1	0
19	2	0	0	2	2	0	2	2	2	2
20	2	0	1	0	1	1	0	1	0	1
21	2	0	2	1	0	2	1	0	1	0
22	2	1	0	2	2	1	0	0	1	1
23	2	1	1	0	1	2	1	2	2	0
24	2	1	2	1	0	0	2	1	0	2
25	2	2	0	2	2	2	1	1	0	0
26	2	2	1	0	1	0	2	0	1	2
27	2	2	2	1	0	1	0	2	2	1

The choice-sets were divided in two separate sets of 9 situations, since these 27 situations still place a significant level of cognitive burden on the respondent. Which likely results in a decrease of response rate and/or decrease in response reliability (Hensher, Rose, & Greene, 2015). To avoid these matters, the total set of 27 situations is divided in three separate sets of nine situations.

Each alternative combination act as independent hypothetical scenario, and labels “Option 1”, “option 2” and “None of the options” were assigned. An example of the choice set can be seen on Figure 12.



Specification		Option A	Option B	None of the options
Building Amenities	*Base Rent*	900 euros	900 euros	
	Type of apartment	1 bedroom apartment	2 bedroom apartment	
	Building use	Mixed-use building	Serviced Appartment (Gym or common room incl.)	
	Type of outdoor space	No outdoor space	Balcony	
	Walkability	Low (Services > 1.5km)	High (Services ≤ 800m)	
Location and building type	*Distance to city centre*	7 mins by bike	15 mins by bike	
	Distance to main activity	18 mins by bike	12 mins by bike	
	Distance to nearest public transport	3 mins walking	3 mins walking	
	Facade	Ordinary building	Ordinary building	
	Height	High rise (≥ 8 stories)	Mid-rise (4 to 7 stories)	
What option do you find more attractive?		○	◉	○

Figure 12 Choice set

3.7 Questionnaire construction

To complement the discrete choice experiment, personal and demographic information was included in the questionnaire, as well as the respondents personal experience related to the current living situation. The discrete choice experiment is dependent on the integrity of the data collected from respondents, and if the tasks are too long or too difficult data quality will suffer and not contain the information sought (Kemperman, 2000). To avoid desertion or differences in interpretation, task uniformity is sought and respondents are given examples of choice tasks and attribute information. And to stimulate respondents' involvement, they are given information to set the domain of the experiment and to inform about the objectives of the experiment. Figure 13 and 14 shows examples of scenario and example of choice task found in the questionnaire. The full questionnaire can be found in Appendix 6.

The information recovered from the respondents, was analyze using a Multi Nominal logit model (MNL) further described in Section 3.11.

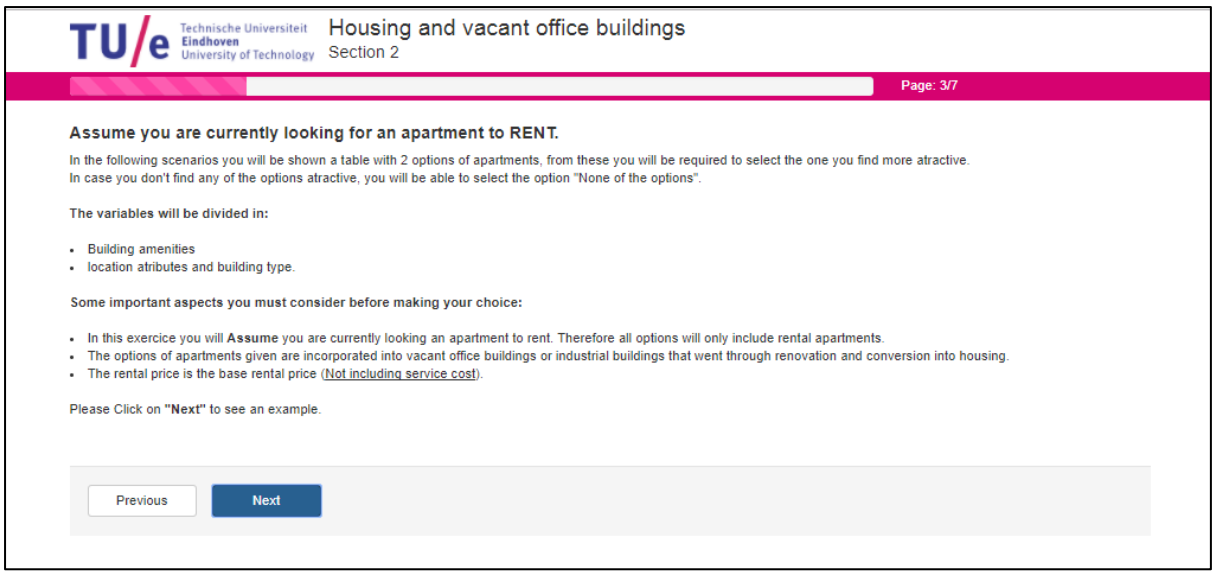


Figure 13 Example of hypothetical scenario

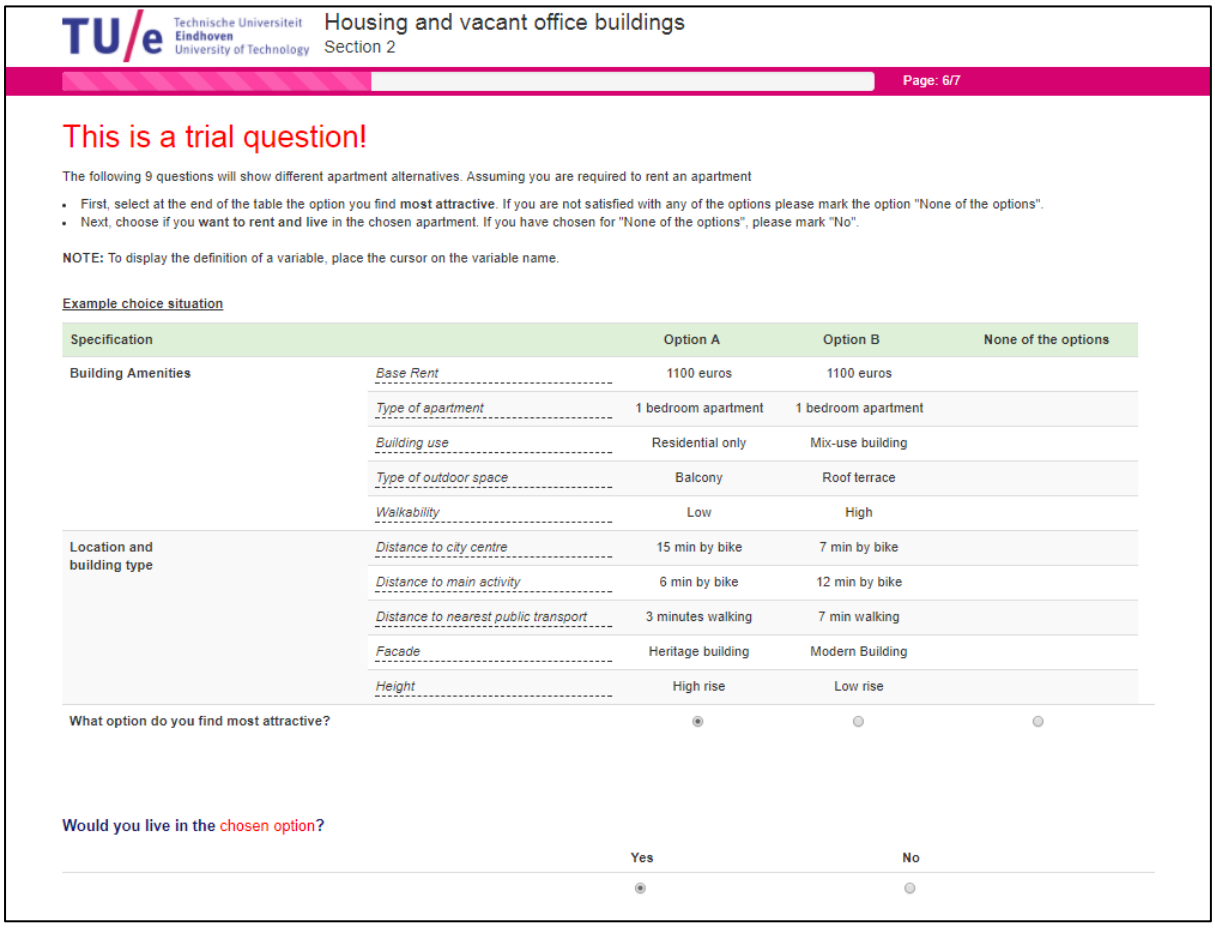


Figure 14 example of trial question

3.8 Data collection

For this choice experiment, the data was collected using the online questionnaire system "Berg Enquete System 2.2" a system designed by TU/e developer Joran Jessurun in 2007. The system offers the opportunity to spread the questionnaire online. The questionnaire is divided in three parts:

- Section 1: Personal experience related to the current living situation of the respondent is collected;
- Section 2: This is where the choice experiment is located. Its goal is to ask about the housing needs of the respondent;
- Section 3: Personal information from the respondent will be collected.

Before starting the survey, the respondents are informed about the context of this survey in an introduction page and the total duration of the questionnaire is set to around 10 to 15 minutes, which is considered as an ideal range according to Galesic & Bosnjak (2009). If the respondent is satisfied with the purpose of the study, he or she can continue to the actual questionnaire. The survey responses will be anonymous, therefore demographic questions are asked only to compare respondent's preference by socio-demographic groups.

The questionnaire was open from: April 18, 2017 until May 16, 2017 and was promoted on social media such as Facebook using sales groups and expats groups from main cities of the Netherlands. The advantages of an online questionnaire are that it is fast and effective in reaching many people in a short period of time and he online questionnaire provides the respondents with the opportunity to decide when they want to start the questionnaire. Also 1000 flyers where created and written in both English and Dutch and delivered in mailboxes in different part of Eindhoven. An example of the flyers can be found in Appendix 7.

It was announced that a Cinema Gift card will be raffle among the respondents who finish the survey. This was done in order to increase the number of respondents, although this can result in a partly biased result since a fraction of the participants could answer the survey randomly in order to finish rapidly and enter to the raffle.

Response rate

The questionnaire was accessed 1772 times resulting in 253 complete responses. The big amount of entries might be due to an error in the website, since there were registered several unfinish entries within seconds apart from the same IP address. Therefore, an exact percentage of response rate cannot be calculated.

Data Cleaning

From the 253 respondents, 3 where rejected because the respondents only chose for the "None of the options" response, 5 more were rejected because they selected all "Option 1" or all "Option 2" in the questionnaire and 15 more were rejected since they responded the

questionnaire in less than 3 minutes. Because of the doubts if the reliability of these answers it was decided to remove them. Leaving a total of 230 completed and usable surveys.

Most of the principles that influence sample size determination are based on statistics, although some researchers have developed heuristics for quickly determining sample sizes based on experience, rules-of thumb, budget and time constrains.

As a rule of thumb, (Orme, 2010 in Rose & Bliemer 2013) suggests a minimum sample size of 200 respondents for studies involving an analysis of differences between sample segments McFadden (1984) on the other hand proposes, ''sample sizes which yield less than thirty responses per alternative produce estimators which cannot be analyzed reliably by asymptotic methods.'' Therefore 40 responses per alternative is preferred.

A more appropriate sample size can be calculated with the general rule of thumb proposed by Orme (2010).

$$N \geq 500 \frac{Lmax}{Sa}$$

Where:

N is the sample size;
L represents the highest number of level attributes;
S Number of choice sets;
a is the number of alternatives.

Considering Ormes rule of thumb

$$N \geq 500 \frac{3}{9 * 3} = 55.5$$

For the current study, the minimum sample of respondents is set at 200, with no less than 40 respondents per socio-demographic group following McFadden (1984) rule of thumb.

3.9 Classifying Respondents

The decision of selecting a product depends on the characteristics of the person and the attributes of the alternatives available to the person. When studying the choice behavior of a specific target group this ensures that the individuals within this group have similar needs and benefits sought by them when acquiring a product.

In this research, the respondents can be categorized based on their answers on section 1 “Personal experience” and section 3 “personal characteristics”.

Origin of respondents

Thanks to the distribution of the survey through social media it was possible to reach several regions of the country, having better response rate (149 complete responses) from the North Brabant region, since it was in Eindhoven where the flyers were distributed, followed by South Holland region with a much lower response rate of 30 responses. In Figure 15 are represented the number of responses by each region of the Netherlands.

Figure 15 Origin of respondents

Respondent demographics and experience

From the 230 filtered respondents, 54% are female and 54% male and 61% have a bachelor or lower degree meanwhile 39% have a Master or doctorate degree.

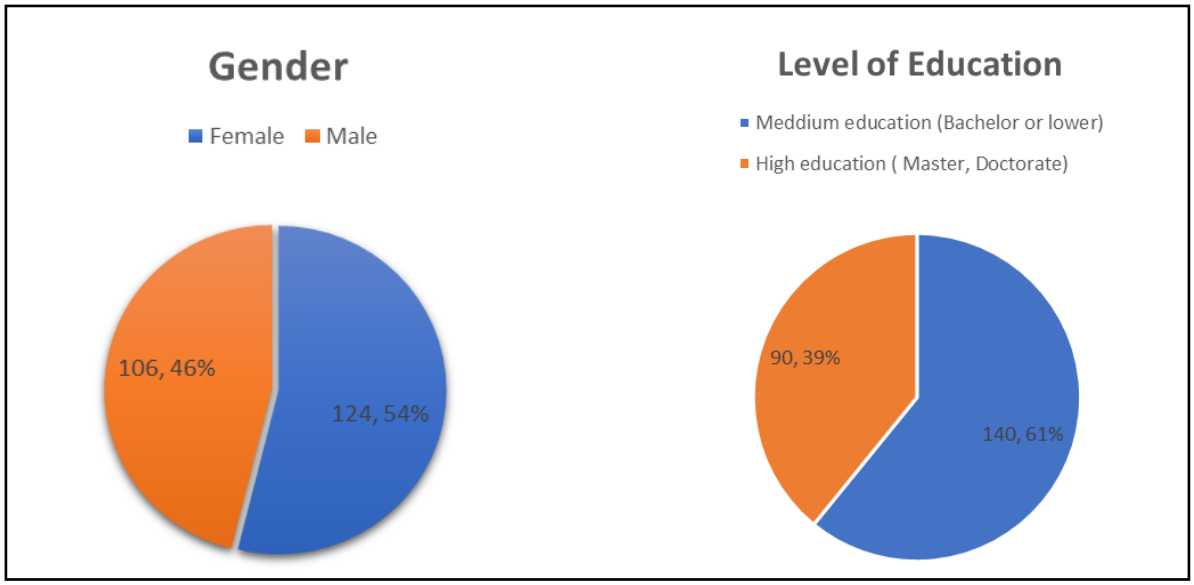


Figure 16 Gender and level of education of respondents

62% of the respondents are currently living in an apartment and 38% in a house and 78% of the total surveyed population are currently renting dwelling. Since the flyers from the questionnaire where delivered in mailboxes of apartment buildings in the city centre of Eindhoven this might have cause the greater number of apartment dwellers.

This can be classified as an advantage since the respondent can directly relate to the alternatives given in the discrete choice experiment since they are experiencing mostly living in an apartment and mostly renting at first hand.

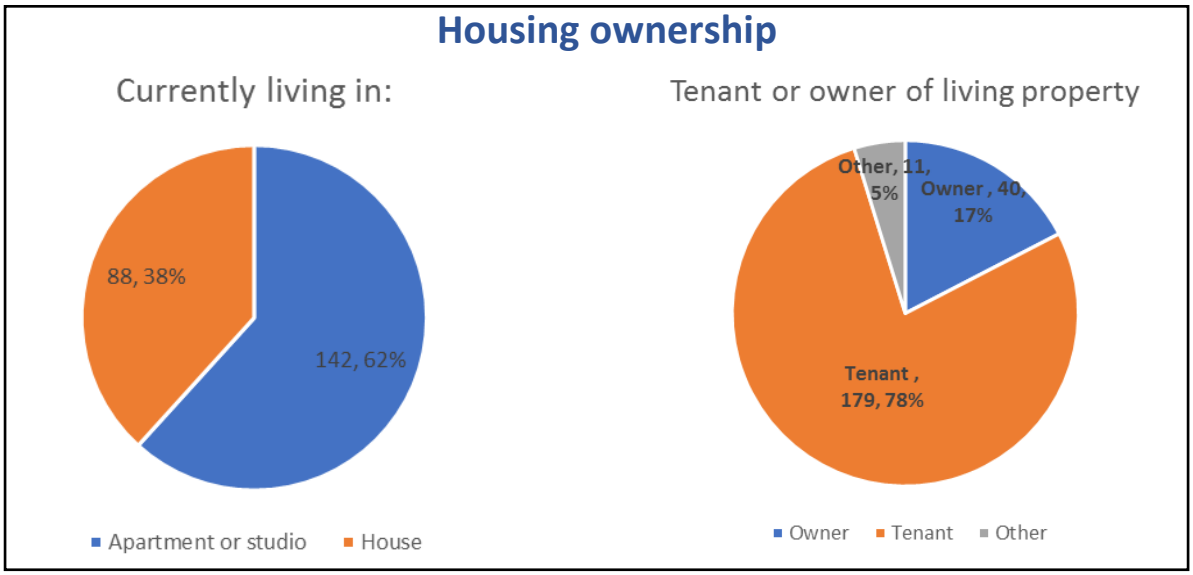
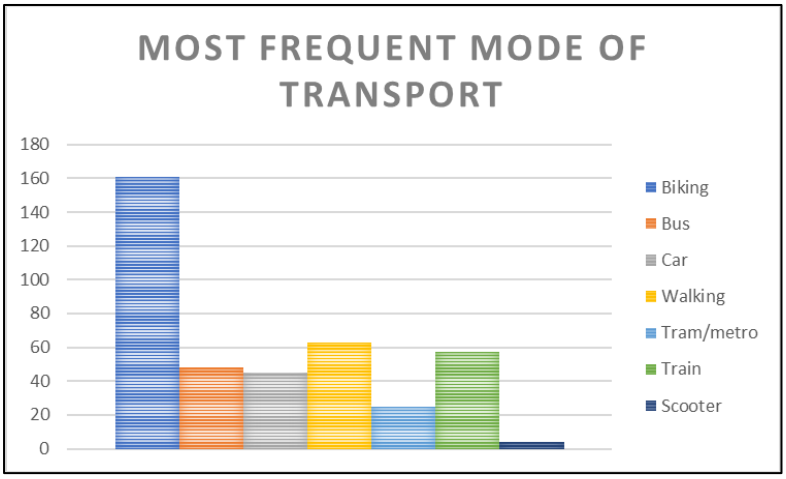


Figure 17 Housing ownership of respondents

It was found that 70% from the respondents choose bike as one of the most frequently modes of transport they use, followed by walking (27%), train (24.8%), bus (20.90%) and car (19.60%) with tram and scooter as the modes of transport less frequently used (10.9% and 1.7% respectively).

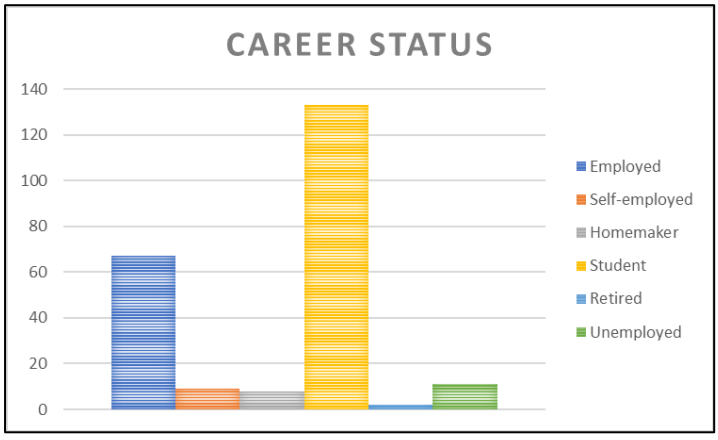
Observing this we can conclude that using bike time-distance and walking time-distance was a good mode of time-travel reference for the attribute referring to distance to certain locations.



Transport		
	Respondents	Percentage
Biking	161	70%
Bus	48	20.90%
Car	45	19.60%
Walking	63	27.40%
Tram/metro	25	10.90%
Train	57	24.80%
Scooter	4	1.70%

Figure 18 Most frequent mode of transport used by respondents

The big use of bike and low use of car, can be a cause of the young population of the respondents by which 57.8% of them are still students, followed by employed people as the second largest group.

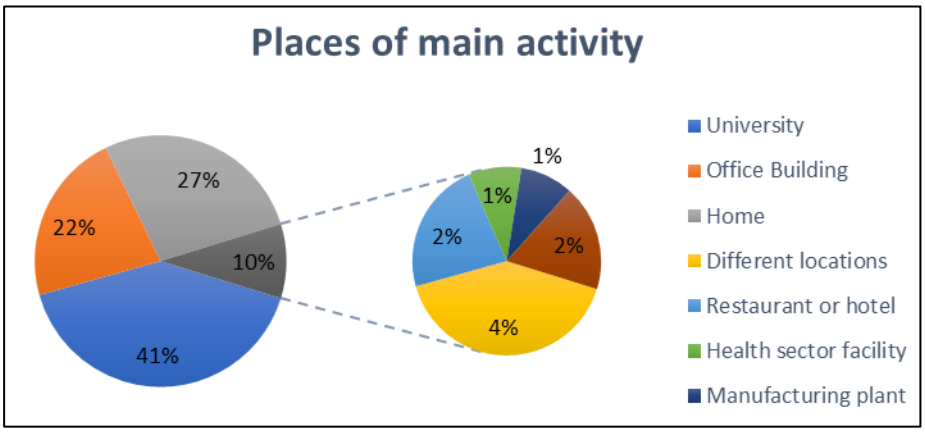


Career status		
	Respondents	Percentage
Employed	67	29.10%
Self-employed	9	3.90%
Homemaker	8	3.50%
Student	133	57.80%
Retired	2	0.90%
Unemployed	11	4.80%
Total	230	100%

Figure 19 Career status of respondents

The main activity place varies from person to person, mostly depending on their professional career. from the 230 respondents, the three biggest groups where they carry out their main

activity 94 (40.9%) said they spend most of the time in universities, 63 (27.4%) at home and 22.2% in office buildings.



Place of Main Activity		
	Respondents	Percent
University	94	40.90%
Office Building	51	22.20%
Home	63	27.40%
Different locations	9	3.90%
Restaurant, hotel or leisure facility	5	2.20%
Health sector facility	2	0.90%
Manufacturing plant	2	0.90%
Other	4	1.70%
Total	230	100%

Figure 20 Place where respondents realize their main activity

From the respondents, almost half of them wish to be able to rent furnished apartments. And when they were asked about the level of importance of energy label when choosing a rental apartment, 51% declare that they do not think is important when taking the decision, and 49% declare it was indeed important.

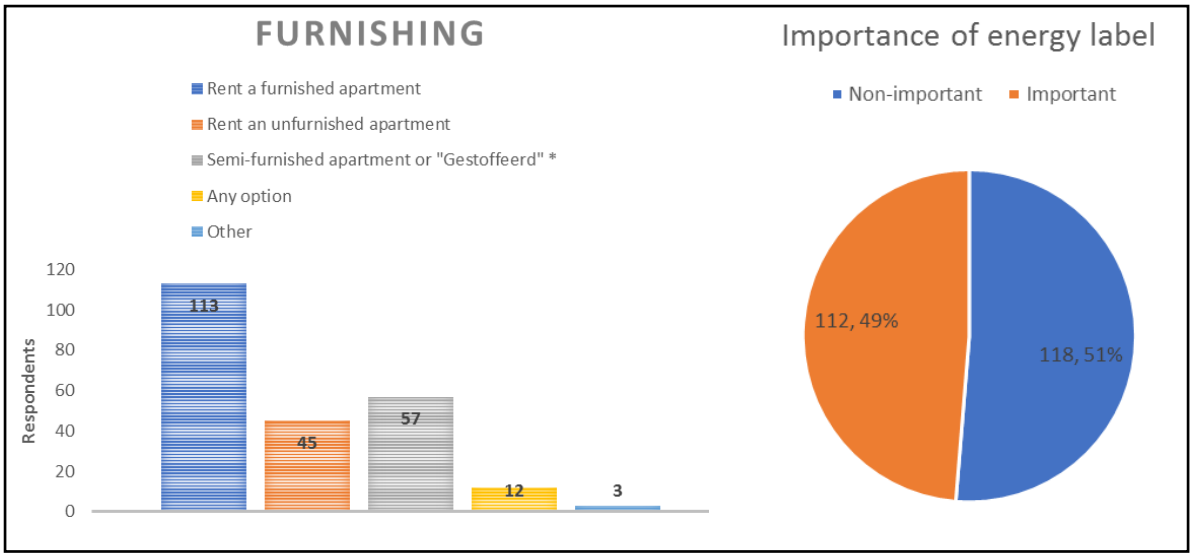


Figure 21 Desire level of furnishing and importance of energy label

3.10 Life cycle categories

Real Estate professionals usually divide the market in different life cycle stages: Nest leaver, Young professionals, Parents with children, Active retirees, and Empty nester (See chapter 2.9). This lifecycle stage can be specifically defined by age range, household composition and professional career (Van Middelkoop & Boumeester, 2014).

For example: Large-lot family housing tends to be preferred by most families with children, which represents a minority of a total adult lifespan, Young adults and seniors tend to prefer smaller homes and more accessible, multi-model locations. But, even people who aspire to own a single-family home may prefer other housing types for much of their lifecycle.

Consequently, respondents will be classified depending on their Household composition, carrier (student or non-student), age range, and nationality as a new interest group to be analyzed to identify their preference and tradeoff based on a multi nominal model (MNL) (See chapter 3.11 and 3.12).

From all the 230 respondents, 46 were Dutch respondents and 184 where people originally from outside The Netherlands, resulting in 20% Dutch respondents and 80% International respondents.

Dutch and Non-Dutch		
	Respondents	Percent
Dutch	46	20%
Non-Dutch	184	80%
Total	230	100%

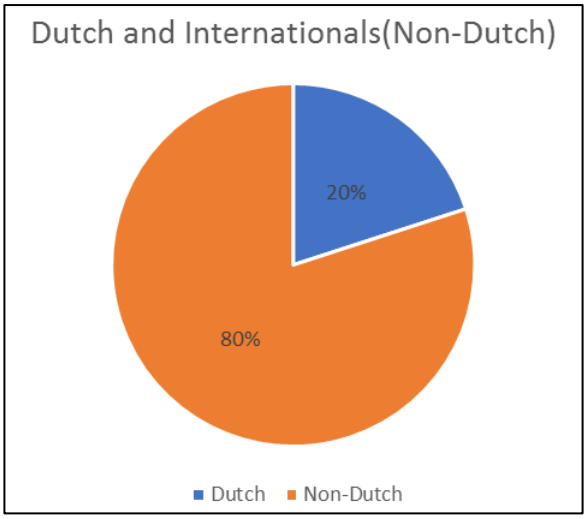


Figure 22 Percentage of Dutch respondents and Non-Dutch (Internationals)

From the internationals group, people originally from India where the biggest nationality group to answer the survey with 40 responses, followed by Mexicans with 17 responses and Chinese with 9 responses. This can be seen in Appendix 8.

The big number of internationals respondents will allow to analyze the preferences of this group in terms of housing. When internationals arrive to The Netherlands, they first look for a place to rent, since most of them just stays for a certain period of time, or they will first rent before deciding to buy a house.

For the respondents, 135 of them are students and 95 are non-students. Since the current housing rental market is growing for students in The Netherlands, the choice preferences of these groups will be analyzed using the MNL model to see how they differ from each other.

Student and Non-students		
	Respondents	Percent
Student	133	57.80%
Non-stude	97	42.20%
Total	230	100%

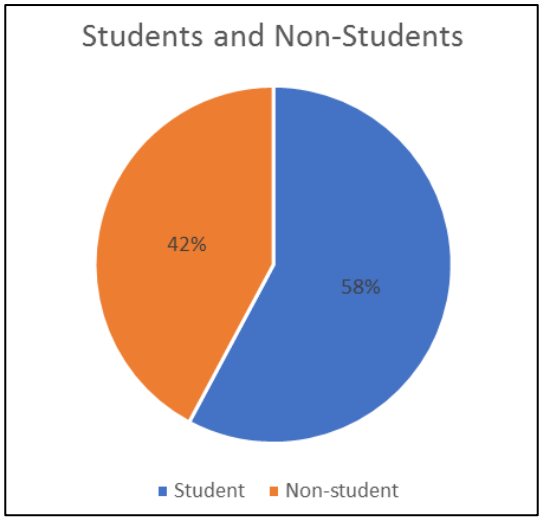


Figure 23 Percentage of students and non-students

As the targeted market segments are highly related to age it is important to know the age of the respondents. Most of the people who completely answered the survey can be categorized as young people, since the biggest groups are between 25 to 31 years old with 104 respondents and 81 respondents between 18 and 24 years old. And only having 45 responses from people above 32 years old.

Ages		
	Respondents	Percent
18 to 24 years	79	34.30%
25 to 31 years	104	45.20%
32 or older	47	10.40%
Total	230	100%

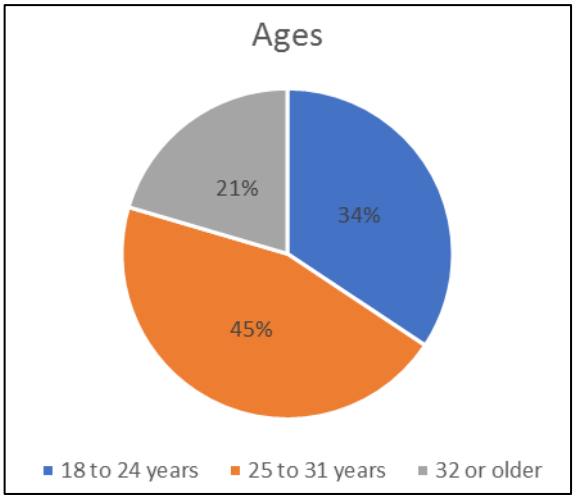


Figure 24 Percentages of ages categories

Current household composition

Household size is also relevant to the different housing market segments. Household size is the most important way of categorizing the market, since it defines the most important need from the future buyer or renters, the bigger the household is, the need or priorities changes. From the respondents of the survey, 61 of them are currently living by themselves, 85 share housing with other people, like roommates, or parents. 63 of them live with their current partner and only 21 live with their children, due to the low number of respondents living with children this specific group won't be analysed, since the respondent rate is below 30 responses.

Household Composition		
	Respondents	Percent
One person household	61	26.50%
Living with others (roommates, parents, siblings)	83	36.10%
living with partner	65	28.30%
living with children	21	9.10%
Total	230	100%

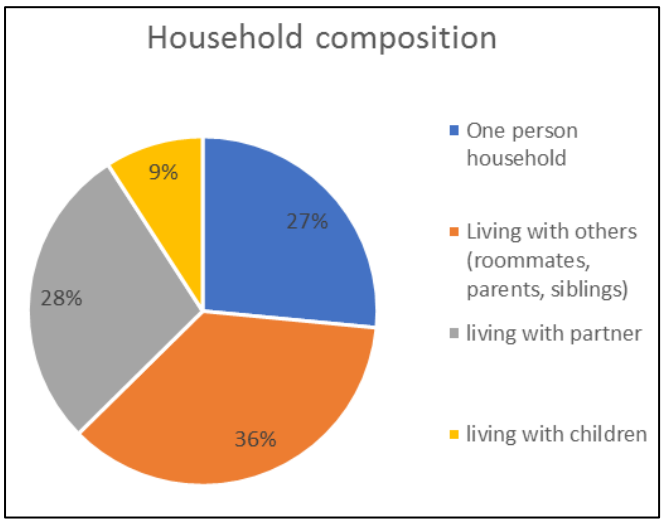
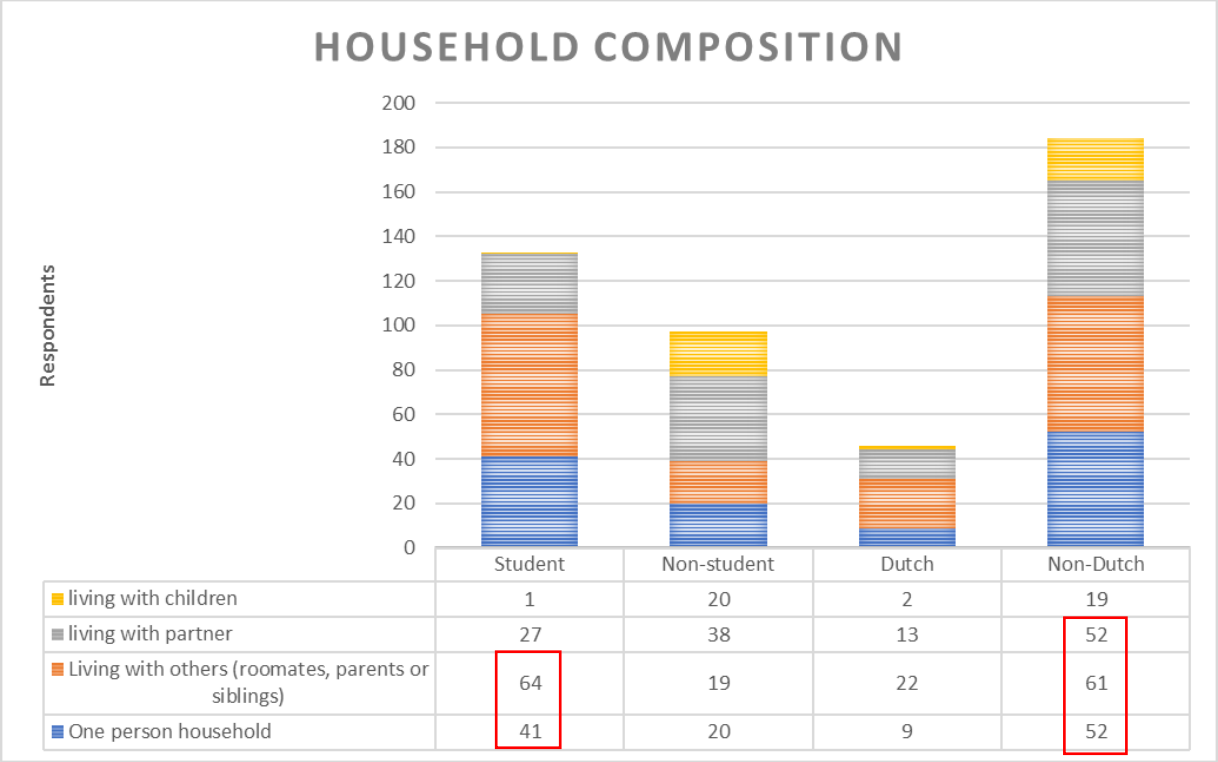


Figure 25 Percentages of household composition

Sub-categories

Thanks to the big amount of student, non-students respondents group and International (Non-Dutch) respondent's groups this can be sub-categorized in Household composition to better understand what are their housing preferences of these groups.

In Figure 26, we can see that both students and Internationals (non-Dutch) meet with the minimum number of respondent required to subdivide them in household composition subgroups, therefore, only students and internationals will be subcategorized (see figure 26 groups marked in red).



	Student	Non-student	Dutch	Non-Dutch
living with children	1	20	2	19
living with partner	27	38	13	52
Living with others (roomates, parents or siblings)	64	19	22	61
One person household	41	20	9	52

Figure 26 Household composition by groups

The student group make up a total of 135 respondents, from which 41 of them don't share housing, and 67 live with roommates or parents, students living with their partners won't be included in the model due to the low response rate.
Meanwhile Non-students can be divided in 20 living in one person household, 36 living with their partners, and 39 living with roommates or close family but no children, even though, the groups living with partner and 3 or more person household are close to the minimum number of respondents required, they will not be included in the study.

Being the internationals group a group with a great response rate, it is possible to define 3 subgroups; one-person household internationals living with partner, and internationals living with others, with 52, 52 and 61 respondents.

3.11 Utility

Individual consciously or subconsciously make decisions by comparing alternatives and selecting an action that we call a choice outcome. The analyst is in constant look on ways to capture the individual's choice behaviour. Individual preferences determine what alternative provides the highest level of satisfaction (or utility). To be able to say that an individual prefers this combination implies that an individual acts as if they are maximizing the level of satisfaction. This is commonly referred to as a behavioral rule expressed as utility-maximizing behaviour (Hensher, Rose, & Greene, 2015). The utility maximization rule is based on two fundamental concepts. The first is that the attribute vector characterizing each alternative can be reduced to a scalar utility value for that alternative. This concept implies a compensatory decision process; that is, it presumes that individuals make "trade-offs" among the attributes characterizing alternatives in determining their choice. The second concept is that the individual selects the alternative with the highest utility value (Koppelmann & Bhat, 2006). Utility is represented with the following formula:

$$U_i = V_i + \varepsilon_i$$

Where:

U_i is the true utility of the alternative I;

V_i is the deterministic or observable portion of the utility estimated by the analyst;

ε_i is the error or the portion of the utility unknown to the analyst.

3.12 Multinomial logit model (MNL)

In the stated choice approach the MNL model is often used, mostly because it is simple to use. It allows the modeler to estimate the probabilities of choices, by including data of individual sets of choice alternatives.

In the MNL model, the error terms are assumed to be independent and identically distributed (IID) according to a double exponential distribution. This means that the error terms of different alternatives have the same standard deviation and are not correlated. Consequently, the cross-elasticity between all pairs of alternatives is identically. Therefore, the probability ratios of choosing an alternative over another is unaffected by the presence of additional alternatives in the choice set. This independence from irrelevant alternatives (IIA) assumption makes that the choice model is easy to compute and alternatives can be introduced and eliminated without re-estimation (Train, 2009).

For the current choice experiment, two unlabelled alternatives and a "None of the options" choice are used. Some of the advantages of using a "no choice" or "own" base alternative are that it would make the choice decision more realistic and would lead to a better predictions of the market penetrations. A disadvantage of the no-choice alternative is that it may lead respondents to avoid difficult choices, which detracts from the validity using the no-choice probability to estimate market shares. However, Johnson & Orme (1996) (retrieved from (Haaijer, Kamakura, & Wedel, 2001)), claims that this seems not to happen in conjoint choice

experiments. In addition, the no-choice alternative gives no information about preferences for attributes of the choice alternatives, which is the main reason for doing a conjoint choice experiment.

The utility function for an alternative represents a linear equation corresponding to the functional relationship of attributes upon the utility level derived for that alternative.

$$V_i = \beta_{0i} + \beta_{1i} f(X_{1i})^2 + \beta_{2i} f(X_{2i})^2 + \beta_{3i} f(X_{3i})^2 + \cdots + \beta_{ki} f(X_{ki})^2$$

Where:

V_i is the deterministic or observable portion of the utility estimated by the analyst;

β_{1i} is the weight (or parameter) associated with attribute X1 and alternative i.

β_{0i} is a parameter not associated with any of the observed and measured attributes, called the alternative-specific constant (ASC), which represents on average the role of all the unobserved sources of utility (Hensher, Rose, & Greene, 2015).

β_{0i} indicates the general attitude toward the proposed housing alternatives. This attitude can be positive or negative and it is indicated by the sign of the variables' coefficient. When β_{0i}'s value is positive indicates that the alternative is of interest and that the respondents or socio-demographic groups are positive toward this type of housing. On the other side, when the value of β_{0i} is negative, it suggests that the respondent or group of respondents is not interested in the proposed types of housing. Similar to any other variable, the bigger the value of the β_{0i} coefficient, the more influence it has on the overall preference of a certain group (Vasilache, 2013).

Effect coding

An effect is the impact an attribute level has on probability. For experimental designs, an effect is defined as the difference in treatment means. A main effect is defined as the direct independent effect of each attribute upon the response variable, choice. The main effect, therefore, is the difference in the means of each level of an attribute and the overall or grand mean. An interaction effect is an effect upon a response variable, choice, obtained by combining two or more attributes which would not have been observed had each of the attributes been estimated separately (Hensher, Rose, & Greene, 2005).

The experiment will only estimate the main effects as no interactions between the chosen attributes are considered to be relevant.

The experiment will estimate non-linear effects by using effects coding. In Effect coding the estimated utility constant can be interpreted as the average utility attached to the alternatives included in the experiment (Jansen, Coolen, & Goetgeluk, 2011). With effect coding the three attribute levels are transformed into L-1 variables (e.g. Price1, Price2). The level is set equal to 1 when the level is present, 0 when not present and -1 when the reference

level is present. The estimated coefficients are used to calculate the utility of each level by multiplying the estimated parameter with its code and summing the results across the coded columns (Hensher, Rose, & Greene, 2015).

Attribute level	3 Levels		Utility
0	1	0	B_{1i}
1	0	1	B_{2i}
2	-1	-1	$-(B_{1i} + B_{2i})$

Table 9 Effects coding

For the attribute level 0, this is:

$$V_i = \beta_{1i}\, x\,(1) + \beta_{2i} x\,(0) = \beta_{1i}$$

For the attribute level 1, this is:

$$V_i = \beta_{1i}\, x\,(0) + \beta_{2i} x\,(1) = \beta_{2i}$$

For the attribute level 2, this is:

$$V_i = \beta_{1i}\, x\,(-1) + \beta_{2i} x\,(-1) = -(\beta_{1i} + \beta_{2i})$$

Where:

V_i is the utility of alternative I;

B_i is the weight (or parameter) associated with attribute X1.

Goodness of fit

This paragraph will go through the basic knowledge on how to check if the used model is viable, in other word if the model fits the observed data. The Log likelihood ratio statics and Mcfaden Rho square will be described in this section

Log likelihood

The log-likelihood (LL) is defined in such a way that it maximizes the prediction obtained by the model. To determine whether the overall model is statistically significant, the analyst must compare the LL function of the choice model at convergence to the LL function of some other, "base model."

$$LL_\beta = \sum_{n=1}^{N} \sum_{i} y_{ni} \ln(P_{ni})$$

Where:

LL_β is the Log likelihood of the estimated model

N is the total sample size used in the model;

Y_{ni} is the choice of one individual *n* made for an alternative *i* which can be 0 or 1;

P_{ni} is the probability of the individual *n* choosing alternative *i.*

$$LL_0 = \sum_{n=1}^{N} \sum_{t} \ln(1/J)$$

LL_0 is the log likelihood of the null model or base model with all parameter of β=0;

N is the total sample size used in the model;

J is the total number of alternatives in choice set *t* for individual *n.*

McFadden's Rho Square

The ρ^2 of McFadden is used to measure the goodness of fit, showing how well the model is able to predict observed choices.

$$\rho^2 = 1 - (LL_M/LL_0)$$

Where:

ρ^2 is the Rho square of McFadden;

LL_m is the likelihood function for the estimated model;

LL_0 Is the likelihood function for the model estimated with no coefficients, or based model.

P^2 gives values between 0 and 1, with 1 indicating that the model predicts the observed data perfectly and 0 indicating that the model with estimated parameters is no better than the model with zero parameters (Train, 2009). Values of ρ2 between 0.2 and 0.4 indicate extremely good model fits, being equivalent to explained variances in linear regression analysis (R2) of 0.7 to 0.9 (Louviere, Hensher, & Swait, 2000).

4. RESULTS

A general MNL model and several others groups models and sub- groups models were generated in Nlogit 5.0 and parameters where estimated for several socio demographic groups divided by:

Groups

- Household composition
- Age categories
- Students vs non-students
- Dutch-vs non-Dutch

Subgroups

- Household composition of students
- Household composition of internationals

The first two are relevant in the sense that developers and brokers look up and add more importance to this target groups. The last two are current trends on real estate market, due to the increase in demand of student housing and the great increase of foreigners arriving to the Netherlands.

The ρ^2 was obtained from the results displayed by Nlogit, all values are between 0.2 and 0.4, the lowest ρ^2 value is for the general model (0.2718) but once divided in groups this value stays above 0.3 for all groups indicating extremely good models. (See Appendix 9 and 10).

4.1 General model

Nlogit 5.0 was used to calculate the studied variables within a MNL model. The influences of the third attribute level were calculated by summing the estimates of the first two estimates multiplied by -1 (Effect coding). Figure 27 show the results. The estimates on these tables show the preference coefficients for each attribute level, were a higher coefficient indicates a stronger preference.

In all the MNL models, the "Constant" variables indicate that respondents rather choose one of the housing alternatives rather than the no preference option. Tables in white represent those Attributes whose coefficients fall below 90% confidence level.

From the resulting coefficients and tables, we can deduce that most attributes varied as expected: Lower prices, bigger space, private outdoor space, services apartments and higher neighborhood walkability were preferred. The "Walking time to the place of main activity" did show minor difference since biking time of 12 min is slightly preferred than a shorter 6 min distance.

The attributes "Façade", "Building Height", and "Distance to Public Transport" didn't show any significant influence, indicating that all the levels are not different from zero and thus, all preferred equally and indicating that these attribute levels can be easily exchanged for another level.

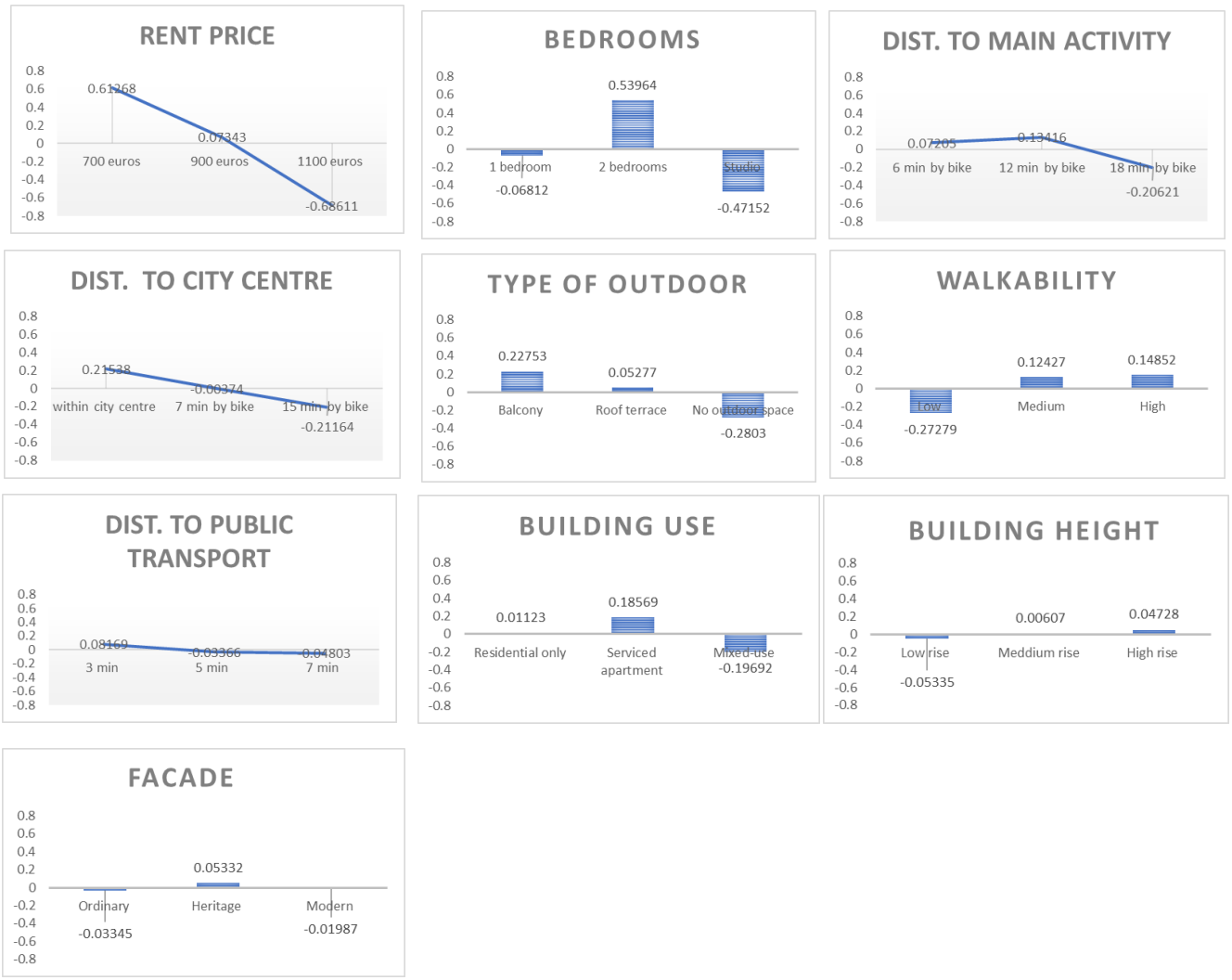


Figure 27 Attribute level preference representation

4.2 Segment based MNL models

From the data gathered in the section 1 and 3 of the questionnaire it was possible to divide the data in different socio-demographic categories. This resulted in 4 categories blocks of MNL models divided by nationality: Dutch and Non-Dutch; age categories: 18-24 years old, 25 to 31 years old and older than 32 years old; Household composition: one person household, two person household (Couples), three or more person household (living with roommates), and living with children; Carrier: Student and Non-Student. Appendix 9 shows all the target groups preferences along with their model fit in more detail.

The first category block corresponds to the Dutch and Non-Dutch (Internationals). The Non-Dutch group has a better model of fit than the Dutch group since this group has increase its homogeneity, reaching a value of 0.3397 and 0.3275 respectively. The positive sign of the B_0 constant on both the Dutch and non-Dutch model suggests that generally respondents have a positive attitude towards the proposed alternatives and the significance of the coefficient comes to support this. There are some differences on the Alternative levels, for example, the building façade level 2 that corresponds to "Ordinary building façade" has significant negative values that no other group has. Each group has different preferences but, overall both Dutch and Internationals prefer low prices, more number of rooms, private outdoor spaces and closeness to city centre and high Walkability in their Neighborhood.

DUTCH **NON-DUTCH (INTERNATIONALS)**

Figure 28 Dutch vs Non-Dutch preferences

The second block are Students and Non-students, this groups have ρ^2 values of 0.3205 for students and 0.3487 for non-students. Students have a bigger preference over low cost apartments, meanwhile for non-students is significant, but not as much as in other groups. They both prefer more number of rooms, private outdoor spaces, high walkability in the neighborhood, and closeness to city centre. Students do prefer to live closer to their Main Activity place, like universities, in comparison with the non-students group, and students prefer "Serviced apartments" while non-students prefer "Residential only apartments" Non-students also have a significant value in one alternative that is only seen again in the group of people over 32 years old. In this case is the "Height of the building" having a preference for medium size buildings.

STUDENTS **NON-STUDENTS**

Figure 29 Students vs non-students preferences

The third block will define the preference depending on their household composition, in this group the number of respondents living with children doesn't reach the minimum survey sample size, since only 21 persons living with children answered the survey. For this research will also be included for comparison means only. All groups have B_0 constant values and all have preference for lower prices, more bedrooms, prefer serviced apartments, and to live closer to the city centre. For people living in couples, there is a preference for a roof terrace over balconies as well as for medium walkability over high walkability and for people living with more than 3 people, closeness to their main activity is important. Figure 30 show the main differences in attribute preferences. Appendix 12 show the complete figures of attributes preference. Utility and ρ^2 values can be seen in appendix 9.

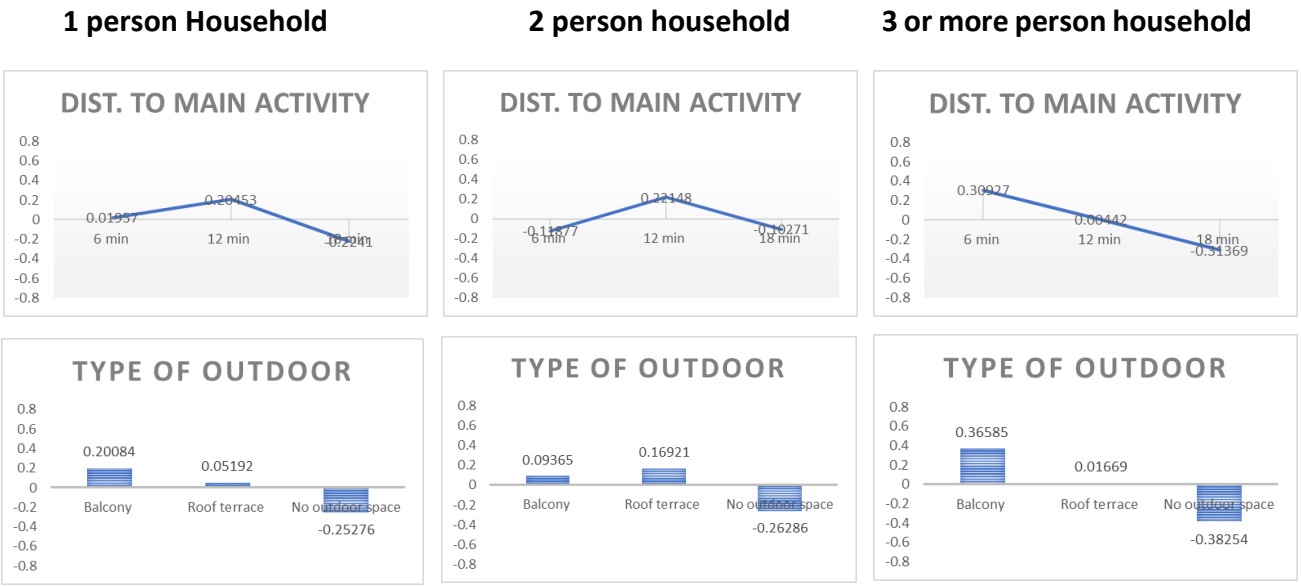


Figure 30 Main differences in preference for household composition

The fourth block divides the respondents by ages. Due to the low response rate of people over 32 (42 respondents) this would be the last category in this block. As expected all groups has a preference over low prices, number of bedrooms, and private outdoor space, although people over 32 years old have less significant preference for low prices than other groups. Respondents between 25 and 31 years old have a slightly bigger preference for roof terraces, but since its it preference is almost the same as balcony (difference is 0.003) it could be said they prefer both roof terraces and balconies and could be easily traded off. Young people prefer to live closer to their main activity, and older people have a bigger preference for living at 12 min distance and apparently Younger people slightly prefer to live in a residence only building but it could be easily trade of by a serviced apartment; meanwhile older people prefer to live in serviced apartments. All groups dislike to live in a neighborhood with low walkability, and people over 32 years old have a significant dislike for high rise buildings.

Figure 31 show the main differences in attribute preferences. In Appendix 13 tables representing the attribute levels performance for each of the Group categories are found. Utility and ρ^2 values can be seen in appendix 9.

18-24 years old **25-31 years old** **32 or more years old**

Figure 31 Main differences in preference for age groups

Preferred alternatives

From the Design Matrix proposed at the beginning of this research (Table 8 on chapter 3.6) we can re-use it to introduce data of different choice alternatives, the utility that these alternatives will deliver to the future user can be generated. Table 10 Categories utilities tablegives an overview of the 27 presented alternatives and their related utilities for each group, revealing which alternative from that specific set is the best (highlighted in green)or worst (highlighted in red) for each group. The description of each alternative can be seen on Appendix 11.

Table 10 Categories utilities table

Profile number	General	Nationality (Dutch)	Nationality (Internationals)	Students	Non-Students	Household (1 person)	Household (2 person)	Living with others (Roommates)	People with Children	Ages 18-24	Ages 25-31	Ages 31+
1	-0.74556	-1.13753	-0.74556	-0.95582	-0.61015	-1.26096	-1.29703	-0.39998	-0.0335	-0.87485	-1.08068	-0.64173
2	-0.74069	-0.70164	-0.74069	-1.02879	-0.38661	-0.52965	-0.26406	-1.41482	-0.89562	-1.21613	-0.20411	-0.61426
3	-0.77644	-0.74002	-0.77644	-1.09915	-0.22808	-0.78984	-0.46133	-1.29602	0.3746	-0.86651	0.24322	-1.2308
4	-0.17054	0.32426	-0.17054	-0.428	0.57013	-0.20951	-0.01531	-0.16043	0.52977	-0.13032	0.71819	-0.37232
5	0.00815	-0.05735	0.00815	-0.43104	0.5762	-0.20534	0.52254	-0.26567	0.07577	-0.26568	0.76265	-0.20337
6	-0.27702	-0.1563	-0.27702	-0.44119	-0.09741	-0.7691	-0.44243	-0.20906	0.78586	-0.4017	0.14864	-0.37666
7	-1.24432	-0.51795	-1.24432	-1.44644	-0.55176	-1.11184	-1.39138	-1.29863	-0.04507	-1.05757	-0.5361	-1.41475
8	-1.31268	-2.61676	-1.31268	-1.48272	-1.7468	-1.16413	-1.87437	-1.80896	-1.52903	-1.86205	-1.72593	-1.32125
9	-0.91589	-1.14428	-0.91589	-0.93841	-1.10563	-0.84103	-0.96638	-1.37477	-0.21291	-1.00471	-0.51396	-1.15572
10	0.06864	0.0761	0.06864	-0.21251	0.50889	0.03122	0.59944	-0.34018	0.79902	-0.38319	0.05405	0.45895
11	-0.85913	-1.85243	-0.85913	-1.02405	-1.03898	-0.99967	-0.89113	-1.07848	-1.51486	-1.09536	-1.25638	-0.9684
12	0.80642	1.07028	0.80642	1.09139	0.53705	0.68105	0.52602	1.41674	0.631	0.94422	0.82058	0.80669
13	0.64396	0.82638	0.64396	0.50443	0.95117	0.30756	0.69823	0.97658	0.74606	0.72416	0.78345	0.56753
14	0.04361	0.22673	0.04361	0.0246	0.153	-0.07293	0.55145	0.30944	-1.30955	-0.09154	0.18156	0.11665
15	1.15164	0.93064	1.15164	1.10933	1.17655	0.87447	1.07187	1.18772	2.42457	0.99284	1.32429	1.1475
16	0.0725	-0.22433	0.0725	0.10708	-0.13898	-0.23306	-0.14207	0.3518	0.41797	0.26503	-0.18035	-0.06804
17	-1.21422	-2.01111	-1.21422	-1.17588	-1.58059	-0.94208	-1.39723	-1.63285	-1.32948	-1.74695	-1.95665	-0.86476
18	-0.05255	-0.17041	-0.05255	0.13982	-0.45282	0.35119	-0.43608	-0.09241	-0.40582	-0.01925	0.02083	-0.17489
19	-0.12867	-0.29091	-0.12867	0.01912	-0.36812	-0.10235	-0.13218	-0.29583	-0.09301	0.46238	-0.31761	-0.59275
20	0.79348	1.0487	0.79348	1.08612	0.57512	1.12384	0.78493	1.0344	-0.21101	1.08485	0.59574	0.8749
21	0.96887	1.53745	0.96887	1.12397	0.91647	0.98641	1.25783	1.27005	0.22995	0.75164	0.20856	1.77789
22	1.16797	1.87918	1.16797	1.42588	1.16646	1.25759	1.25445	1.60719	0.65353	1.97623	1.25119	0.92424
23	1.62254	1.88274	1.62254	1.74411	1.62445	1.48637	1.58812	1.97754	1.43766	1.76218	1.35337	1.83302
24	0.66645	1.22312	0.66645	0.84275	0.60632	0.66044	1.15523	0.89955	-0.21934	0.72025	0.55318	0.83722
25	0.43709	0.25019	0.43709	0.79519	-0.14425	0.98457	0.11904	0.52752	-0.7425	0.70779	-0.44491	0.58249
26	-0.11334	-0.26966	-0.11334	0.04008	-0.58581	-0.12705	0.01171	-0.3723	-0.3064	0.20958	-0.34261	-0.28722
27	0.09973	0.61491	0.09973	0.61013	-0.32582	0.61383	-0.42988	0.48186	-0.25766	0.41466	-0.46021	0.35984

Note: The "People living with children group" will be included in the table for comparison reasons, however this group doesn't reach the minimum number of respondents therefore the reliability of this data is low.

From Table 10 Categories utilities table, we can conclude that the best alternative is number 23 since it represents the maximum utility for almost all the group categories (shown in color green), the alternative least preferred in most cases is number 8.

Alternative 23 includes

- 700 euros base rental price
- Two bedroom apartment
- Mixed-use building
- Balcony
- Medium Walkability (Services between 800 m and 1.5 km)
- Within city centre
- 12 min by bike to main Activity
- Seven min walking to public transport stop
- Ordinary building
- High rise

4.3 Mixed sub-groups

Thanks to the big number of Student and Internationals (non-Dutch) respondents, it was possible to divide this groups by its household composition to analyze their preferences according to its household size.

In all the groups, we can observe good models of fit and big values of the Constant B_0 coefficient suggests that generally respondents have a positive attitude towards the proposed alternatives. (see appendix 10).

For the internationals, all the household groups prefer lower prices, more number of bedrooms, shorter distance to city centre and high neighborhood walkability. For outdoor space internationals living with their partner (two person household) prefer roof terraces over balconies, meanwhile internationals living with roommates have a bigger preference for balconies and prefer shorter distances to their main activity place in contrast with people living by themselves and people living in couple. Also, it can be seen that walkability significance decreases as the household composition increases, being the internationals living alone the ones that care the most for walkability, meanwhile two person household and three or more person household can easily accept a medium level walkability**.** (See Appendix 10 for full data and 14 for full charts).

Internationals

1 person Household | **2 person household** | **3 or more person household**

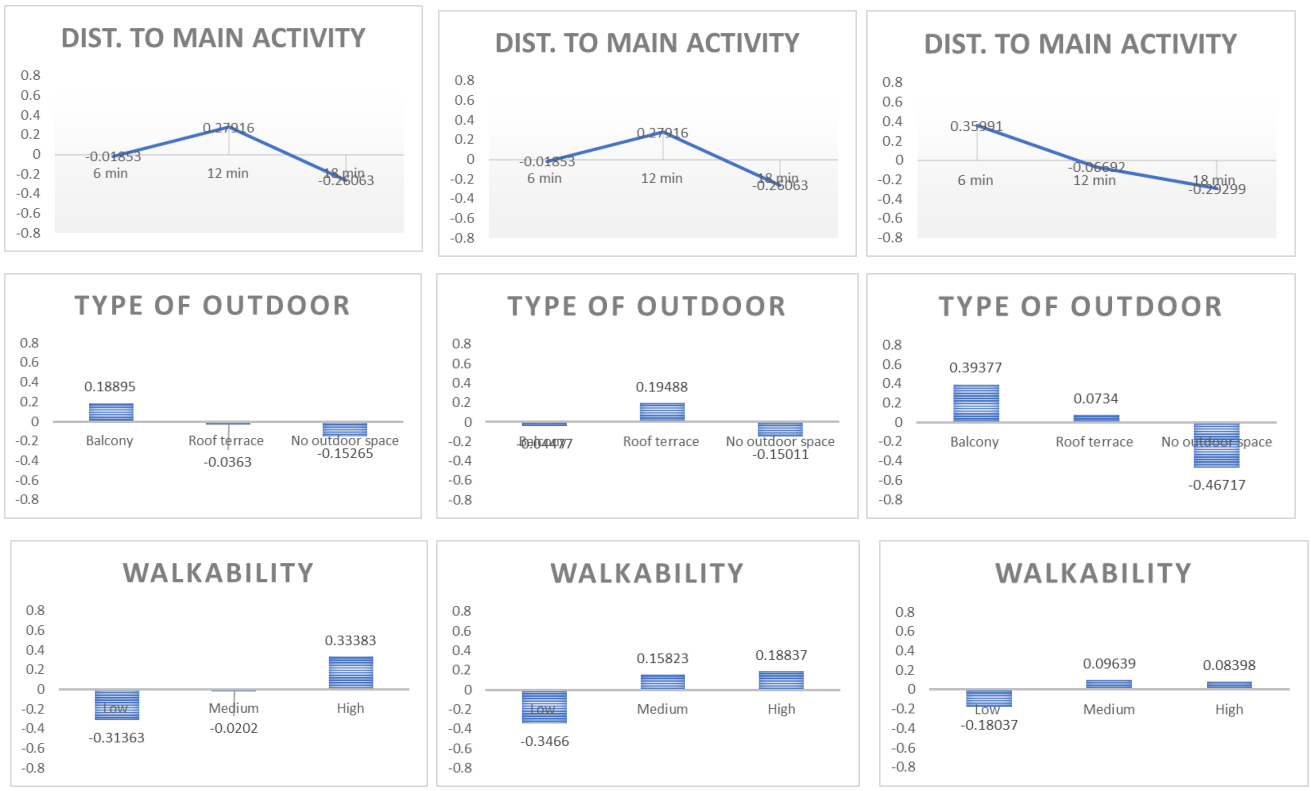


Figure 32 Main differences in preference for household composition of internationals

In the household composition subcategory for students, all students prefer lower prices, higher walkability, and shorter distance to city centre. We can observe from the models that even though they both prefer more number of bedrooms, students living with other people have a significant bigger preference for two-bedroom apartments than students living by themselves, whose preference for two or one-bedroom apartments is not significantly different compared with studios. Students living with others also have a bigger preference for balconies and bigger dislike for no outdoor space, meanwhile for students living alone having a roof terrace or no outdoor space make not much difference. Students living with other prefer shorter distances to their place of main activity and city centre, meanwhile students living alone, don't have big preferences for shorter distances. (See appendix 15 for full charts).

Students

1 person household **3 or more person household**

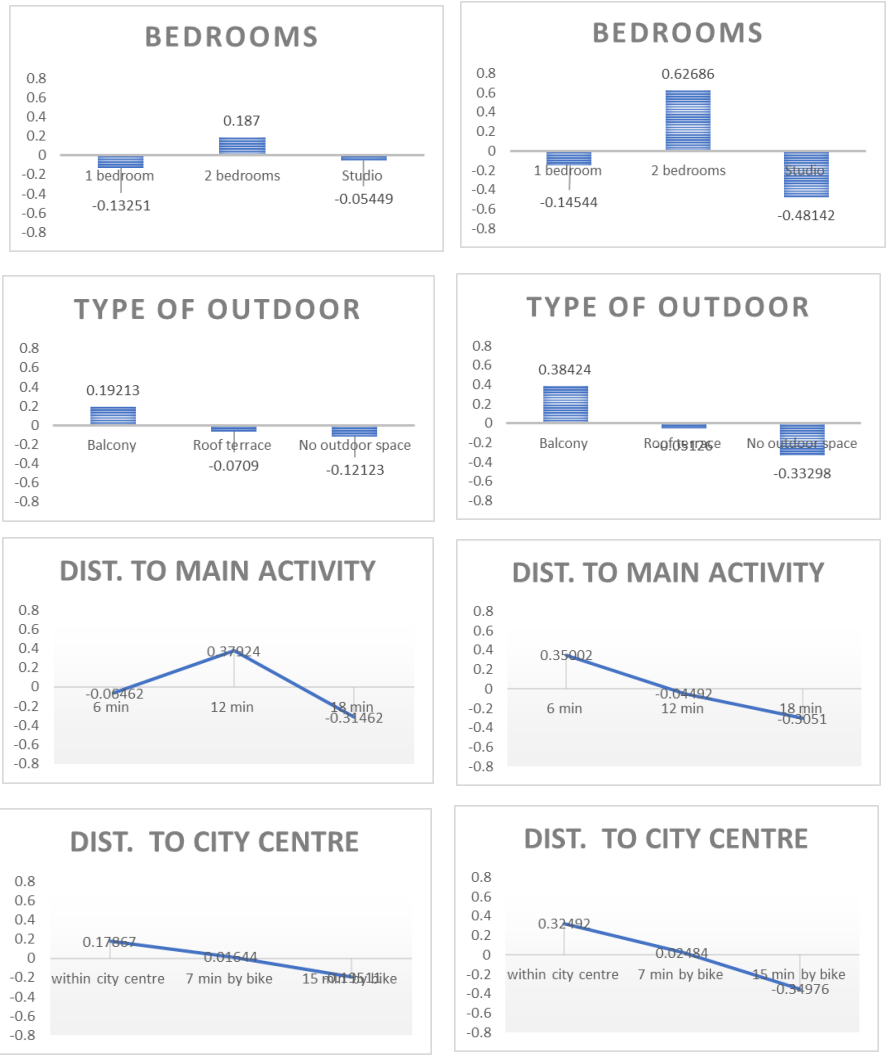


Figure 33 Main differences in preference for household composition of students

Table 11 Utility table for sub-categories

Profile number	Students 1 person HH	Students 3+ person HH	Internationals 1 person HH	Internationals 2 person HH	Internationals 3+ person HH
1	-1.39639	-0.66207	-1.49589	-1.42078	-0.08957
2	-1.16228	-1.38899	-0.78329	-0.2176	-1.32308
3	-1.01391	-1.35511	-0.84091	-0.55936	-1.33793
4	-0.6573	-0.42183	-0.54833	-0.31258	-0.04751
5	-0.79648	-0.41717	-0.43384	0.49586	0.04054
6	-1.16027	-0.25027	-0.84885	-0.46861	-0.18371
7	-1.50614	-1.35117	-1.39786	-2.04148	-1.25234
8	-1.17621	-1.87085	-1.12434	-1.49008	-1.47668
9	-0.65617	-1.19209	-0.68627	-0.82852	-1.56941
10	-0.03066	-0.50106	-0.13674	0.59384	-0.4053
11	-0.73462	-1.33307	-0.91262	-0.44656	-1.00422
12	0.86383	1.63046	0.75101	0.48629	1.41768
13	-0.04442	0.81861	0.04801	0.74966	1.10682
14	-0.45456	0.2665	-0.21214	0.49316	0.42213
15	1.55606	1.02812	1.15485	1.30316	1.03911
16	-0.05878	0.38769	-0.32707	-0.05359	0.53697
17	-0.21056	-1.69151	-0.6864	-1.06699	-1.83315
18	0.60195	0.09221	0.62674	-0.40819	-0.24351
19	0.2593	-0.04617	0.0267	0.0824	-0.42406
20	0.79284	1.26271	1.05973	0.69521	1.01564
21	1.2293	1.08434	1.13132	1.03649	1.13879
22	1.12715	1.83462	1.31923	1.26722	1.39067
23	1.5922	1.90846	1.59989	1.40609	2.06312
24	0.52062	0.8747	0.5877	1.0532	0.83648
25	1.75257	0.77028	1.46741	0.17627	0.33515
26	-0.11788	-0.02873	-0.04959	-0.11065	-0.35869
27	0.88081	0.55139	0.71155	-0.41386	0.20606

Observing the utility table for sub-categories, it can be concluded that alternative number 23 represent the maximum utility for this set of alternatives (cells highlighted in green), except for the students one-person household group whose maximum utility can be found in alternative number 25.

Alternative 23 includes, best fit for internationals and 3 or more household students

- 700 euros base rental price
- Two bedroom apartment
- Mixed-use building
- Balcony
- Medium Walkability (Services between 800 m and 1.5 km)
- Within city centre
- 12 min by bike to main activity
- Seven minutes walking to public transport stop
- Ordinary building
- High rise (8 or more stories high)

Alternative 25. Best alternative for students living in a 1 person household includes

- 700 euros base rental price
- Studio apartment
- Residential only building
- No outdoor space
- High Walkability (Services within 800 m)
- Within city centre
- 12 min by bike to main activity
- Five minutes walking to public transport stop
- Heritage building
- High rise (8 or more stories high)

4.4 Supportive tool

The MNL models developed from potential user choice studies can be easily incorporate into to create a supportive tool so that the impact of changes in the levels of attributes on choice shares can be predicted. Also, tradeoffs in different attributes levels can be tested to find the best target group depending on the fixed characteristics of the building to transform. By introducing data from different alternatives, utilities generated or probabilities generated by them can be predicted.

Input

1. Select fixed attributes and flexible attributes for the new housing project (Office building to housing).

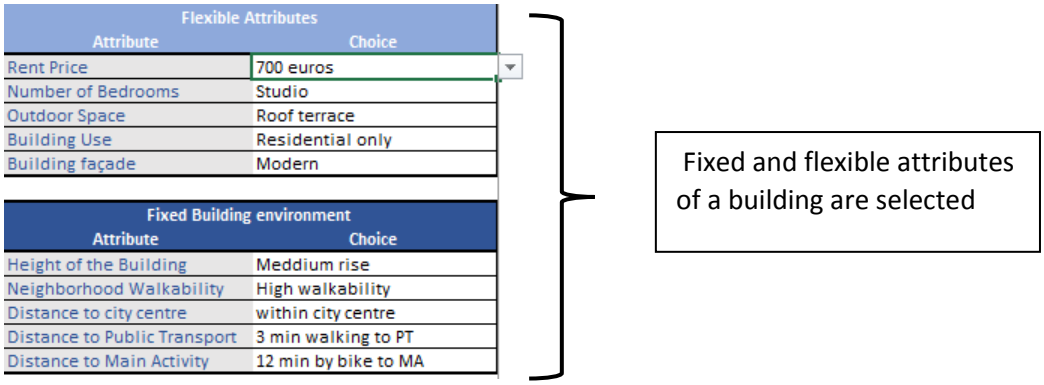


Figure 34 Supportive tool example input

Output

1. In the sum blocks, the higher utilities will be highlighted in green.
2. Compare fixed, flexible and total sum of utilities. The block 'utility percentage' will show the percentage of maximum utility possible for each group.
3. Decision maker can modify flexible attributes until reach desire results for the best interest of the project.

Groups with bigger preference for the attributes selected are highlighted in green.

Attribute	Choice	General	1 person household	2 person household	3+ person household (no children)
Rent Price	700 euros	0.61268	0.76485	0.62325	0.79222
Number of Bedrooms	Studio	-0.47152	-0.2744	-0.72296	-0.57986
Outdoor Space	Roof terrace	0.05277	0.05192	0.16921	0.01669
Building Use	Residential only	0.01123	-0.03742	-0.03409	0.10756
Building façade	Modern	-0.01987	0.00176	0.12677	-0.06008
		0.18529 Utilities flexible attributes	0.50671	0.16218	0.27653 Utilities flexible attributes
Height of the Building	Meddium rise	0.00607	0.09465	0.06149	-0.05802
Neighborhood Walkability	High walkability	0.14852	0.2386	0.08747	0.09572
Distance to city centre	within city centre	0.21538	0.19171	0.28558	0.33253
Distance to Public Transport	3 min walking to PT	0.08169	-0.06096	0.09131	0.10284
Distance to Main Activity	12 min by bike to MA	0.13416	0.20453	0.22148	0.00442
		0.58582 Utilities fixed attributes	0.66853	0.74733	0.47749 Utilities fixed attributes
		0.77111 Sum of utilities	1.17524	0.90951	0.75402 Sum of utilities
		2.24589 max utility possible	2.41961	2.63467	3.21519 max utility possible
		34% Utility percentage	49%	35%	23% Utility percentage

Example: One person household has a bigger preference for the flexible attributes and two person household has a bigger preference for the fixed attributes. The sum of all utilities results in a bigger preference for one person household obtaining 49% of the total utility possible for this group.

Attribute	Choice	Ages 18-24	Ages 25-31	Ages 32+	Students	Non-students
Rent Price	700 euros	0.89884	0.2663	0.70107	0.85415	0.38498
Number of Bedrooms	Studio	-0.45483	-0.24312	-0.4827	-0.37235	-0.73694
Outdoor Space	Roof terrace	-0.09459	-0.02319	0.19939	0.0037	0.10676
Building Use	Residential only	0.18774	0.02747	-0.06182	-0.02123	0.15371
Building façade	Modern	-0.02577	0.08689	0.04555	-0.04162	0.07449
		0.51139 Utilities flexible attributes	0.11435	0.40149	0.42265 Utilities flexible attributes	-0.017
Height of the Building	Meddium rise	0.01652	0.14202	0.00575	-0.01484	0.14633
Neighborhood Walkability	High walkability	0.19115	0.16522	0.0616	0.18202	0.03974
Distance to city centre	within city centre	0.23884	0.26762	0.24442	0.21219	0.3049
Distance to Public Transport	3 min walking to PT	0.10608	0.01919	0.05835	0.05078	0.03957
Distance to Main Activity	12 min by bike to MA	-0.02965	0.05987	0.31031	0.10989	0.17549
		0.52294 Utilities fixed attributes	0.65392	0.68043	0.54004 Utilities fixed attributes	0.70603
		1.03433 Sum of utilities	0.76827	1.08192	0.96269 Sum of utilities	0.68903
		2.74496 max utility possible	2.44856	2.53155	2.6167 max utility possible	2.44762
		38% Utility percentage	31%	43%	37% Utility percentage	28%

Attribute	Choice	Dutch community	International community	
Rent Price	700 euros	0.87508	0.61268	
Number of Bedrooms	Studio	-0.6766	-0.47152	
Outdoor Space	Roof terrace	0.07532	0.05277	
Building Use	Residential only	0.13171	0.01123	
Building façade	Modern	0.2115	-0.01987	
		0.61701	0.18529	Utilities flexible attributes
Height of the Building	Meddium rise	0.1359	0.00607	
Neighborhood Walkability	High walkability	0.03258	0.14852	
Distance to city centre	within city centre	0.38086	0.21538	
Distance to Public Transport	3 min walking to PT	-0.03759	0.08169	
Distance to Main Activity	12 min by bike to MA	0.12715	0.13416	
		0.6389	0.58582	Utilities fixed attributes
		1.25591	0.77111	Sum of utilities
		3.444	2.24589	max utility possible
		36%	34%	Utility percentage

Figure 35 Supportive tool example output

Sub-categories

		STUDENTS			INTERNATIONALS			
Attribute	Attribute	1 person household (Students)	3+ person household (Students)		Internationales (1 person household)	Internationales (2 person household)	Internationales (3 person household)	
Rent Price	700 euros	0.89299	0.9124		0.87266	0.57693	0.68924	
Number of Bedrooms	Studio	-0.05449	-0.48142		-0.16287	-0.69301	-0.6284	
Outdoor Space	Roof terrace	-0.0709	-0.05126		-0.0363	0.19488	0.0734	
Building Use	Residential only	-0.06163	0.0921		-0.11606	-0.10656	0.12787	
Building façade	Modern	-0.16371	-0.02695		-0.03902	0.01602	-0.09056	
		0.54226	0.44487	Utilities flexible attributes	0.51841	-0.01174	0.17155	Utilities flexible attributes
Height of the Building	Meddium rise	0.08879	-0.07102		0.08329	0.0304	-0.1263	
Neighborhood Walkability	High walkability	0.33621	0.18139		0.33383	0.18837	0.08398	
Distance to city centre	within city centre	0.17867	0.32492		0.19309	0.15997	0.37379	
Distance to Public Transport	3 min walking to PT	0.01691	0.07796		-0.03332	0.13807	0.12491	
Distance to Main Activity	12 min by bike to MA	0.37924	-0.04492		0.27916	0.23224	-0.06692	
		0.99982	0.46833	Utilities fixed attributes	0.85605	0.74905	0.38946	Utilities fixed attributes
Sum of utilities	Sum of utilities	1.54208	0.9132		Sum of utilities	1.37446	0.73731	0.56101
	max utility possible	2.69763	3.34838		max utility possible	2.70034	2.39269	3.24663
	Utility percentage	57%	27%		Utility percentage	51%	31%	17%

Figure 36 Supportive tool output: sub-categories example

Using this supportive tool, it can be determined how the fixed attributes of a building such as location, and physical appearance are a fit for each of the target groups and how the flexible attributes can be manipulated to promote different target groups into moving into the converted building or simply adapt them to increase the preference level or utility percentage the fixed attributes suggest to what target groups is a better fit.

4.5 Case study: Vonderweg 11, Eindhoven.

This section presents a case study to demonstrate the application of the supportive tool to choose the ideal target groups for a transformation project, more specifically office to housing. The case will start by researching about the history and current condition of the building followed by the first instrument of the Transformmeter analysis developed by Geraedts and Nicole de Vrijto (2004), Quick scan, which purpose is to measure the potential for transforming vacant office buildings into homes and end by determining the best target group that fits for this specific project.

The supportive tool allows the developer or party interested in the conversion project, to better determine the best target group that finds attractive attributes of the building that cannot be changed, such as façade style, height of the building and location, and the way it can be adapted to attract various target groups or make it even more attractive to a specific group. Once determined the target group or groups the last two instruments in the Transformmeter, Feasibility analysis and checklist of the possible risk encountered in the transformation project, can be analysed. These two instruments are beyond the scope of this study hence, they won't be analysed in this case.

Figure 37 H.C.Z. in Eindhoven, Netherlands

The H.C.Z. building is located in Vonderweg 11 in Eindhoven, Netherlands and has a floor area of 11.000m2. The building was built in 1980 as an office for AGO insurance. Between 1994 and 1997, was used by Philips Royal Electronics N.V. the abbreviation H.C.Z. Is from Philips and is used for property identification: H = rent C = center Z = object (Theeuwen, 2016).

After the property became vacant in 2007, it was cracked in 2008 by approximately 160 residents but it was and subsequently evacuated by judge orders in 2010. Then in 2013 the facades of the building were demolished. Since then, the carcass is open and exposed in weather and wind.

A spokeswoman from the owner Breevast says that the former Philipspand HCZ in Vonderweg is likely to be demolished to make way for housing; many scenarios were investigated and some were also lost. From her words, it is clear that housing (possibly combined with other functions) is the remaining option. There will be a housing mix for all target groups, but the city council still has to approve the zoning plans (Theeuwen, 2016; van Haaster , 2017).

Demolition and new building creates possibilities for a good fit with current needs (for this case housing). Although one disadvantage is that redevelopment takes time and there is income delay, and if the building is in technically good state, redevelopment is a waste of resources.

On the other hand, conversion is a sustainable way of addressing vacancy. Buildings do not have to be demolished, it directly saves the use of raw materials and the old building materials do not have to be decomposed, burned down or stored under soil, and indirectly helps the environment by saving energy and reducing the discharge of carbon dioxide (Remøy & van der Voordt, 2006).

In this case the first steps, Quickscan and choosing the ideal target groups in the process of approving a transformation project will be analyse (See chapter 2.7, figure 8).

A project plan consists of the technical improvements, financial calculations, tenant approach, and execution decisions. For each part, the redeveloper can make different decisions. The adaptive capacity of the building will be measure using the AC method, (See tables 2 and 3 in chapter 2.7). In the AC method, a value is given for each assessment aspect of the spatial/functional flexibility characteristics and the constructional/technical flexibility. 1=Bad, 2=Business As Usual (BAU), 3=Better, 4=Good.

Table 12 Assessment aspects of the AC method (spatial/functional flexibility)

Spatial /Functional Flexibility

Indicator	Assessment value	Notes
Division support -infill To which degree deals the design of building with the division between support (components with longer life cycle) and infill (components with short life cycle; easy to demount or replace)?	in % of infill 1. 10% 2. 10-30% 3.30-50% 4. > 50% Since all that is left from the building are the structural and support components, a Good assessment value will be determined, since now is very easy to rearrange the building.	The more construction components belong to the infill domain, the more easily a building can be rearranged.
Shape of the layout How is the shape of the layout?	1. Circular or Irregular 2. - 3. Shallow and oblong, and or irregular 4. Equilateral and/ or regular	The more the layout of a building is equilateral and regular, the more easily a building can be rearranged.
Building entrance and location of elevators, stairs, cores To what extend a centralized and/or decentralized building entrance, cores, stairs, elevators, has been implemented.	1. Decentralized and separated building entrance and core. 2. Decentralized and combined entrance and core. 3. Building divided in different wings, each with a centralized and combined entrance and core. 4. Building with one centralized entrance, divided in different wings, each with a centralized and combined entrance and core.	The more a building entrance system can be used for a more independent use, the more easily a building can be rearranged.
Location Is the location of the building capable to support housing/living functions and other functions?	1. Not capable 2. capable 3. Capable for living and other function (care or shops) 4. Capable for living and other 2 functions (Care and shops)	The more a location around a building supports housing and more functions, the more easily a building can be rearranged or transformed.
Building Is the building capable to support housing /living functions and other functions?	1. Not capable 2. capable 3. Capable for living and other function (care or shops) 4. Capable for living and other 2 functions (Care and shops)	The more a building supports housing and more functions, the more easily a building can be rearranged or transformed.

Table 13 Assessment aspects of the AC method (Construction and technically flexibility)

Construction/Technical Flexibility

Indicator	Assessment value	Notes
Measurement System Has positioning and measurement conventions for construction components been used, for the implementation of project independent, demountable and replaceable components?	in % of implementation 1. Not implemented 2. <50 % 3. 50-90% 4. > 90% Since all that is left from the building are the structural and support components, and all the demountable or replaceable components are removed a "Better" assessment value will be determined.	The more project independent, demountable and replaceable construction components has been implemented, the more easily a building can be rearranged and transformed to other function.
Replaceable inner walls To what extend are inner walls easily replaceable?	1. Inner walls are not replaceable without radical/expensive construction interventions. 2. - Inner walls are not replaceable, but good destructible. 3. Inner walls are replaceable by dismantle them, and rebuild them in another location. 4. Inner walls are easily replaceable (System walls)	The more inner walls are easily to be replaced, the more easily a building can be rearranged and transformed to other function.
Measurement grid What is the size of the measurement grid?	1. > 3.60 m 2. Between 2.40 and 3.60m 3. Between 1.20 m and 2.4 m 4. < 1.20m	The smallest the size of the measurement grid the more easily a building can be rearranged or transformed. Horizontal grid based on 1.80m gives great opportunities for layout for living/care and large common rooms as well.
Dismountable facade to what extend can façade components be dismantled?	1. Façade components are not or hardly dismountable and have to be fully demolished and removed (<20%) 2. A small part of the façade components is dismountable (between 20% and 50%) 3. A small part of the façade components is dismountable (between 50% and 90%) 4. Most facade components are easily dismountable. (> 90%) No existing façade.	The more façade components are easily dismountable the more easily a building can be rearranged or transformed.
Self-supporting facade To what extend is the building façade self-supporting (load bearing)?	1. The complete façade is part of the load bearing structure of the building 2. A mayor part of the façade is part of the load bearing structure of the building (>50%) 3. A small part of the façade is part of the load bearing structure of the building (<25%) only the façade in the core is part of the load bearing capacity. 4. The facade is fully self-supporting and is no part of the load bearing structure of the building.	The more a façade is self-supporting and is not taking part of the load bearing structure of the building, the more easily a building can be rearranged and transformed.

Tansformmeter

In order to be able to measure the transformation potential both at location and at building level the "Transformmeter" was developed by Geraedts and Nicole de Vrijto (2004) (See chapter 2.7). In this case study only the Quick scan and the determination of the target groups will be analysed since for the Feasibility analysis and checklist a sketch of the intended layout of the building after transformation is needed along with the number and type of dwelling units intended to build. Depending for what target group the dwelling in intended.

Quick scan

The quick scan is divided in veto criteria and feasibility scan using gradual criteria.

Veto criteria

This quick scan makes use of eight veto criterion. A veto criterion is a criterion which if satisfied, leads to immediate rejection of the idea of converting the office building into housing. This is an effective way of taking out promising candidates quickly from the overall potential market.

Table 14 Quick scan criteria for the building Vonderweg 11, Eindhoven

Quick scan			
General criteria.			
ASPECT	**VETO CRITERIA**	YES	NO
1. Internal veto criteria of property developer	Does not fulfils the requirements regarding location set out by the organization interested in the conversion project		✓
	Does not fulfils the requirements regarding the building conditions set out by the organization interested in the project		✓
2. Backers for transformation plan	There is no enthusiastic developer who believes and supports the project		✓ assumption
3. Housing suitability: Building	Low adaptive capacity See tables 11 and 12		✓
	Does not meets the criteria of current building regulations (building decree)		✓
Location	Serious public risk (pollution, noise, odour)		✓
4. Willingness to sell	Owner or investor Not willing to sell the office building		✓ assumption
5. Zoning plan	Zoning plan does not permit modifications (zoning plans in procedure)		✓

Feasibility scan using gradual criteria

If the results of the Quick Scan indicate that there is no immediate objection to transformation (no single question is answered 'Yes'), the feasibility of transformation can be studied in greater detail with reference to a number of 'gradual' criteria, that express the transformation potential of the building in question in terms of a numerical score. Taken together, these criteria allow a more rounded picture to be built up of the feasibility of the transformation project under consideration.

Table 15 Feasibility scan for location aspects for the office building in Vonderweg 11, Eindhoven.

LOCATION **FUNCTONAL ASPECTS**	YES	NO
Urban location		
1 Building in industrial estate or office park far from town		✓ location: city centre
2 Building gets little or no sun		✓ big parking space and no adjoining buildings
3 View limited by other buildings on > 75% of floor area		✓ building near main avenue
Distance and quality of amenities		
4 Shops for daily necessities > 1 km		✓ (supermarket at 400m)
5 Neighbourhood meeting-place (square, park) > 500 m		✓ Victoria park at 400m (future project)
6 Hotel/restaurant/snack bar > 500 m		✓ Victoripark, Philips stadium, Willemstraat
7 Bank/Post Office > 2 km		Rabobank <1km
8 Basic medical facilities (group practice, health centre) > 5 km		✓ Catharina <4km
9 Sports facilities (fitness club, swimming pool, sports park)		✓ Fitness centre at Philips stadium
10 Education (from kindergarten to university) > 2 km		✓ Tue at 2km
Public transport		
11 Distance to railway station > 2 km		✓ 900 m
12 Distance to bus/underground/tram > 1 km	✓ >1km	
Accessibility by car and parking		
13 Many obstacles; traffic congestion	✓ main street at rush hours	
14 Distance to parking sites > 250 m.		✓ parking site next to building

15 <1 parking space/100 m2 road surface		✓
CULTURAL		
Tone of neighbourhood		
16 Situated on or near edge of town (e.g. near motorway)		✓
17 No other buildings in immediate vicinity		✓
18 Dull environment		✓
19 No green space in neighbourhood		✓
20 Area has poor reputation/image; vandalism		✓
21 Dangerous, noise or odour pollution (factories, trains, cars)	✓ maybe noise pollution	
LEGAL		
Urban location		
22 Noise load on façade > 50 dB (limit for offices 60dB)	✓unknown	
Ownership of ground		
23 Leasehold		✓ building was for sale in 2014.

Total number of Yes's for Location:	4
Default weighting: 5	
Location score	20

Table 16 Feasibility scan for building aspects for the office building in Vonderweg 11, Eindhoven.

BUILDING FUNCITONAL ASPECTS	YES	NO
Year of construction or renovation		
1 Building recently built (< 3 years)		✓ (1980s)
2 Recently renovated (< 3 years)		✓
Vacancy		
3 Some space still in use		✓
4 Building unoccupied < 3 years		✓
Features of new dwelling units		
5 (< 20 -person units (50 m2 each) can be made)		✓
6 Layouts suitable for local target groups cannot be implemented		✓
Expendability		
7 Not horizontally extendable (neighbouring buildings)	✓	
8 No extra storey (pitched roof; insufficient load-bearing cap.)	✓	
9 Basement cannot be built under building	✓	
TECHNICAL		
10 Building poorly maintained/looks in poor condition	✓	
11 Dimensions of skeleton Depth < 10 m		✓
12 Module of support structure < 3.60 m		✓
13 Distance between floors > 6.00 m		✓
14 Support structure (walls, pillars, floors) are in poor/hazardous condition	✓	
15 Facade Cannot be made to blend with surroundings or module > 5.40 m		✓
16 Façade (or openings in façade) not adaptable		✓
17 Windows cannot be reused/opened		✓
18 Installations Impossible to install (sufficient) service ducts		✓
CULTURAL		
19 No character in relation to surrounding buildings		✓
20 Impossible to create dwellings with an identity of their own		✓
21 Unsafe entrance, no clear overview of situation		✓
LEGAL		
22 Presence of large amounts of hazardous materials		✓
23 Acoustic insulation of floors < 4 dB	Unknown	
24 Very poor thermal insulation of outer walls and/or roof		✓
25 (< 10% of floor area of new units gets incident daylight)		✓
Requirements of Dutch building decree		
26 No lifts in building (> 4 storeys), no lifts can be installed		✓
27 No (emergency) stairways		✓
28 Distance of new unit from stairs and/or lift " 50 m		✓

29 Free ceiling height < 2.6m		✓
Total number of Yes's for Building :	6	
Default weighting: 3		
Building score	18	
TOTAL SCORE	**20+18 =38**	

Table 17 Results of feasibility scan

Transformation total score	Transformation class
0 - 40	Class 1: Excellent transformation
41 - 80	Class 2: Transformable
81 - 120	Class 3: Limited transformability
121 - 160	Class 4: Very poor transformability
161 - 199	Class 5: Not transformable

If the results indicate that the building lends itself to transformation (i.e. that it falls into transformation class 1 or 2), the analysis can continue. Since the building on Vonderweg street constituted only of the structural structure the level of conversion is very flexible. The biggest risks for conversion of this building might encounter might fall in the Technical building category risks (See section 2.7), considering that the building façade was demolished in 2013 and since then the carcass is open and exposed. Analysing the building structural conditions is a must do, and therefore the cost of all of these studies must be included in the financial feasibility.

Determining target groups

The fixed attributes of the building revealed a positive utility for all groups. The utility level is especially high for one-person households (0.83114), ages 25 to 31 years old (0.6565), non-students (0.64885), and Dutch citizens (0.63448).

By analysing the student's subgroups and internationals subgroups, it was revealed a bigger utility level for one-person household in both subgroups, being the utilities 1.02017 and 0.98705 respectively.

According to the supportive tool If this building is renewed the previous target groups mentioned are the best fit or this specific building and is recommended to design housing units for these target groups to have a high occupancy rate. By integrating these target groups it could be said that the building is more attractive to "Young professionals" (see chapter 2.9) who are defined as people looking for the 'starter home". This perfectly fits with current real estate market trends that states that highly educated young professionals are being particularly drawn to urban centres such as Eindhoven, Amsterdam, and Rotterdam because

of the diversity and quality of educational institutions, jobs, culture and recreation (Hekhuis, Nijskens, & Heeringa, 2017).

Young professionals are people recently entering the labour force. It can be divided in 2 types: Young single head and young couples with no family dependants.

The next step is to analyse how flexible attributes affect the utility level, measured in percentage of the maximum utility possible for each target group. Three options, A, B, and C will be analysed by setting the type of outdoor space, building use and the building façade, and then divided in 2 types to analyse the living space (number of bedrooms) and base rental price.

OPTION A

Outdoor space: No Outdoor space

Building use: Residential only

Façade: modern

OPTION A1

Flexible Attributes	
Attribute	**Choice**
Rent Price	700 euros
Number of Bedrooms	Studio
Outdoor Space	No outdoor space
Building Use	Residential only
Building façade	Modern
Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 17%

Ideal for

one-person households (43%), ages 18-24 (26%), students (23%), Dutch (22%)

Subgroups

Ideal for: one-person household students (56%), one-person household internationals (51%).

NOTE: Dutch vs internationals group includes all types of household composition, once is subdivided we can note how the preference for the first set of alternatives increases

drastically for one-person household internationals (51%), and heavily rejected by three-person household internationals (-6%), this big difference in preference is the reason of the overall preference of the whole internationals group compared vs Dutch.

Other possible target groups

Only ages 25-31 years old group reaches 20% utility.

In the first option A1 to determine the best flexible attributes to attract Young professionals, it was proposed to build studio apartments with a base rent of 700 euros, no outdoor space, the building will be residential only and the façade will change to a modern façade. This dwelling characteristics change the dwelling preference results as now it is mostly preferred by one-person households, between the ages of 18 to 24, students and Dutch households. Making it ideal for one-person household students and one-person household for internationals.

OPTION A2

Flexible Attributes	
Attribute	**Choice**
Rent Price	700 euros
Number of Bedrooms	1 bedroom
Outdoor Space	No outdoor space
Building Use	Residential only
Building façade	Modern

Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 36%

Ideal for

one-person households (50%), ages 25-31 (41%), non-students (36%), Dutch (38%)

Subgroups

Ideal for: one-person household students (53%), one-person household internationals (53%).

Other possible target groups

Two-person household (44%), all age groups are above 30%, internationals (32%).

If we increase the type of apartment to one-bedroom apartment for trial A2, all the sum of utilities increases for all groups the flexible and fixed attribute characteristics chosen are a better fit for one-person household, ages 25-31 years old, non-students and Dutch households.

In the students and internationals subgroups, the one bedroom apartment is still a god fit for 1 household subgroups. Decreasing by 2% the total utility for one-person student household and increasing 2% for one-person internationals household.

OPTION B

Outdoor space: Roof terrace

Building use: Residential only

Façade: modern

OPTION B1

Flexible Attributes	
Attribute	**Choice**
Rent Price	700 euros
Number of Bedrooms	Studio
Outdoor Space	Roof terrace
Building Use	Residential only
Building façade	Modern
Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 33%

Ideal for: one-person households (55%), ages 32+ (39%), students (33%), Dutch (36%)

Subgroups

Ideal for: one-person household students (51%), one-person household internationals (56%).

Other possible target groups

Two-person household (33%), all age groups are above 30%, internationals (29%).

If the structure of the building allows it, adding some balconies or roof terrace will definitely increase the preference for both one-person households and couples to move in the building.

In option B1, maintaining a low rental price is important keep attracting one-person households. Although, in the subgroups section, the preference for one-person household was barely affected.

OPTION B2

Flexible Attributes	
Attribute	**Choice**
Rent Price	900 euros
Number of Bedrooms	1 Bedroom
Outdoor Space	Roof terrace
Building Use	Residential only
Building façade	Modern
Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 25%

Ideal for: Two-person households (40%), ages 25-31 (40%), non-students (40%), Dutch (24%)

Subgroups

Ideal for: one-person household students (28%), two-person household internationals (40%).

Other possible target groups

One-person household (31%), Ages 32+ (35%), internationals (23%).

Since adding an outdoor space increases the total investment cost, it is recommended to rise the monthly rental price to 900 euros for one bedroom apartments. Still with this increase the building is still attractive to one-person households (31% of total possible utility) but in this case two-person household have a bigger preference for it.

OPTION C

Outdoor space: Roof terrace

Building use: Serviced apartments

Façade: modern

OPTION C1

Flexible Attributes	
Attribute	**Choice**
Rent Price	700 euros
Number of Bedrooms	Studio
Outdoor Space	Roof terrace
Building Use	Serviced apartment
Building façade	Modern

Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 40%

Ideal for: one-person households (65%), ages 32+ (51%), students (45%), Dutch (43%)

Subgroups

Ideal for: one-person household students (72%), one-person household internationals (71%).

Other possible target groups

Two-person household (33%), all age groups are above 30%, internationals (37%).

One last case scenario C will be changing the building use to serviced apartment, this has a significance increase in the preference level for one-person households, especially in the subgroup section.

OPTION C2

Flexible Attributes	
Attribute	**Choice**
Rent Price	900 euros
Number of Bedrooms	1 Bedroom
Outdoor Space	Roof terrace
Building Use	Serviced apartment
Building façade	Modern

Fixed Building environment	
Attribute	**Choice**
Height of the Building	Medium rise
Neighbourhood Walkability	High walkability
Distance to city centre	within city centre
Distance to Public Transport	5 min walking to PT
Distance to Main Activity	12 min by bike to MA

General utility: 40%

Ideal for: Two-person households (46%), ages 25 -31 years old (50%), non-students (39%), Internationals (31%)

Subgroups

Ideal for: one-person household students (42%), two-person household internationals (50%).

Other possible target groups

One-person household (41%), Age 32+ (46%), Dutch (30%), one-person household internationals (41%)

In option C2, one bedroom apartment serviced apartments with a roof terrace for a monthly base rent of 900 euros is preferred by people living in couples (two-person household), ages 25-31, non-students, and both Dutch and Internationals by having almost the same total utility percentage level.

Recommended target groups.

According to the supportive tool, the building on Vonderweg street will be more attractive to Dutch people, living by themselves (one-person household), between 25 to 31 years old, non-students.

If the developer wants to attract more the target groups mentioned before option A2, and B2 are a good fit and these attributes can be use a start point to design the living spaces. Supposing that the developer wants to attract other target groups, option A1, B1, and C1 are a good fit for students who want to live by themselves (one-person households), meanwhile in order to attract couples option C2 should be implemented.

By analysing the results, it can be notice that one-person households prefer low rental prices rather than more number of bedrooms. Therefore, to attract this group low prices must be maintained. Couples give more importance to location and looks of the building than one-person households, and they have a slightly preference for the number of bedrooms over price. (See appendix 12). Hence, to attract more couples one bedroom apartments are recommended.

If the structure of the building allows it, one kind of outdoor space such as a roof terrace can attract more couples and more one-person households, or as an alternative make the building a serviced apartment by including a recreational area or fitness area.

In conclusion, it is recommended to create a mixture of types of apartments of studios with low rental price and one bedroom apartments for a higher rental price. If the structure of the building allows it is highly recommended to add a roof terrace and/or a recreational or fitness area. These last to attributes allows high utility for both one-person households and two-person households.

5. CONCLUSIONS AND RECOMMENDATIONS

Real estate is a product with a large economic value and large spatial-physical impact. This is why it is of great societal importance to use real estate as efficiently as possible. To enable a high-quality use and a high occupancy rate, a building must be able to move along with qualitative and quantitative changes in demand. Different actors may have different interests and needs regarding adaptability. Owners look up for the best possible profitability and users look for an accommodation that adapts to their needs. When a building no longer meets the needs of users or owners, this can go through transformation or redevelopment.

Housing has a big demand in The Netherlands and is still increasing, meanwhile, office buildings have a lower demand resulting in low rental prices. Low rental prices and a lot of vacancy have as a consequence a great number of office vacant buildings, which can give a bad image to an area. Some studies state that vacant office buildings causes commerce and trade to decrease and criminal activity to increase. By transforming vacant buildings recaptures the value of these properties bringing vitality back to once blighted neighborhoods (Bullen, 2007).

This study adds insight into the housing preference of various target groups and the requirements an office building need to meet in order to successfully be converted into housing for specific target groups. With the MNL model, the optimal housing type could be determined for each target group, by considering the fixed characteristics of vacant office buildings and measure its potential for transformation. Unfortunately, vacant buildings with industrial, commercial, or other use different from office fall beyond the scope of this study.

To transform an office building into dwelling by representing population preference best, it is important to decide for what group should be built. For example, in the Netherlands is expected that the number of internationals rises (both Expats and Internationals students) (CBS, Migrantenmonitor, 2014-2015, 2017c) therefore new housing should be available for this group and in order to do that their preferences should be measured, although it was found that origin does not offer a significant difference in preferences level for any of the building attributes.

The bigger differences in target group preferences were noted to be in age group category and household composition. In this study, it was chosen to focus on household composition since is the household composition the one that defines more the needs not only of a single person, but of a group of individuals who are willing to share the housing facilities and look over for the needs of the other members of the family (Buzar, Ogden, & Hall, 2005).

Analyzing the results revealed by the MNL model, it was confirmed that the two main attributes affecting the choice of every target group are price and number of bedrooms. This was also found in another study by Remoy & van der Voordt (2006).

Following price and number of rooms, the distance to the main activity, distance to city centre and walkability level of the neighborhood where the building is located followed as important housing characteristics. Location of a building is something that cannot be changed, hence special attention should be added to its surroundings, like image of the neighborhood and

distance to activity centers, such as office districts, industrial zones, universities and commercial zones. The preference for these locations characteristics varies from group to group. For example, for people living with roommates, the closeness to their main activity and city centre is a priority, meanwhile, couples don't think closeness to main activity is a priority when it comes to choosing dwelling.

Outdoor space and building use play also an important role when choosing housing for some groups. Being sometimes as important as distance to the place of main activity or distance to city centre. The availability of private outdoor proved to be a very important feature for all housing units and buildings that cannot offer any possibility of providing it will offer low utility to possible future residents, no matter the market segment, thus an effort should be made by developers to provide it. Though balconies are preferred in most cases, any other similar solution like roof terraces or French balconies should be adopted.

The MNL model also reveals that all groups have a general dislike for mixed-use buildings. Sometimes developers decide to make mixed-use projects to use the land more efficiently, revitalize the neighborhood by bringing more commercial activity and reduce the long-term maintenance cost of individual buildings by dividing them between the two uses. There are several advantages of creating mixed-use projects but according to the results of this research, trade-off could be made by increasing the walkability level of the neighborhood (by the same building).

Looks of the building play a small role in choice preference for most groups, except for couples and older people in both cases this preference is inclined to modern buildings and heritage buildings respectively.

One of the results of this research is the development of an integrated support tool. This tool can help municipalities, developers, investors, building owners, or other real estate professionals, identify what are the fixed attributes of a building (physical appearance and location) that different target groups find more attractive and suitable for living. Thanks to the supportive tool it can be determined how flexible attributes, such as base rental price, number of bedrooms, outdoor space, use of building, and facade can be manipulated to increase the preference level of a specific target group or to attract different target groups to a new housing transformation project. Knowing the right target group or groups for a specific project might have the potential to assists developers and real estate professionals in choosing the best structure for reuse, by acknowledging the future user's preferences and reducing investment financial risk by expecting a higher rental rate.

Successful case stories of cities such as Toronto and Hong Kong demonstrate how sustainability aims can be fulfilled and tight housing market can be sorted out by the conversion of vacant office buildings to housing. This could contribute to increase and broaden the housing supply and at the same time create a new use for obsolete office buildings.

Municipalities and building owners should increase its awareness of the potential vacant buildings have depending on its surroundings and physical qualities. In uncertain market situations, where the lifespan of new constructions is expected to be shorter, conversion is a

sustainable option since it increases the life span of a building. Developers and architects should incorporate change-of-use adaptability as an important issue in briefing and design of office buildings and municipalities should encourage redevelopments and transformation to make more land efficient cities by allowing flexibility in building codes in the design of future adaptations.

Research regarding building transformation is still scarce, this study adds some further insights into the preferences for transformation projects of different target groups. However, only a limited number of attributes can be taken into account within the stated choice experiment, therefore only ten attributes were included while more attributes might influence choice behavior as well. The order of attributes presented in the stated choice experiment might be another factor affecting the results of the MNL model, since it was noted that the attributes revealing bigger utility for the user are the ones presented at the top of the choice sets, meanwhile, the last attributes presented in the alternatives of the choice sets are the ones with less significance for the respondents, meaning that the options given could be easily exchange for any other of options given in the attributes levels.

Despite these limitations, with the current research, a contribution was made to the better understanding of housing choice behavior and preferences when it comes to conversion projects from office buildings to housing buildings. It was examined which attributes of the building, fixed and flexible, are of greater importance for different target groups. Cities change over time, and also does population preferences. This is when researches like this can help build better cities by managing better the urban environment and focusing well on the durability on new developments and its potential to change if required.

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APPENDICES

Appendix 1

Significant points from demand perspective

SIGNIFICANT POINTS FROM DEMAND PERSPECTIVE	
Location (Living environment) 6. *Representative/Character* **e.** Nature of the building **f.** Social image **g.** Vitality **h.** Greenness 7. *Facilities* **g.** Shops **h.** Bars, restaurants, etc. **i.** Schools **j.** Bank/Post office **k.** Medical facilities **l.** Recreational facilities 8. *Accessibility by public transport* **d.** Distance to public transport **a.1** Frequency and times **e.** Distance to tram or metro **b.1** Frequency and times **f.** Distance to train station **c.1** Frequency and times 9. *Accessibility by car* **d.** Distance to motorway **e.** Traffic though flow **f.** Parking opportunities	**Building (Dwellings)** 11. *Type of house* 12. *Entrance* 13. *Size of home* g. Number of rooms h. Living room i. Kitchen j. Bedrooms k. Sanitary space l. Storage space 14. *Layout of the home* 15. *Level of facilities* 16. *Outside space* 17. *View out and view in* 18. *Environmental factor* g. Heating h. Ventilation i. Noise j. Sun and daylight k. Energy usage l. Material usage 19. *General conditions* e. Accessibility f. Safety g. Alterability h. Adequate management 20. *Costs* c. Purchase or renting price d. Additional costs

Appendix 2

Feasibility scan using gradual criteria

LOCATION FUNCTONAL ASPECTS	YES	NO
Urban location		
1 Building in industrial estate or office park far from town		
2 Building gets little or no sun		
3 View limited by other buildings on > 75% of floor area		
Distance and quality of amenities		
4 Shops for daily necessities > 1 km		
5 Neighbourhood meeting-place (square, park) > 500 m		
6 Hotel/restaurant/snack bar > 500 m		
7 Bank/Post Office > 2 km		
8 Basic medical facilities (group practice, health centre) > 5 km		
9 Sports facilities (fitness club, swimming pool, sports park)		
10 Education (from kindergarten to university) > 2 km		
Public transport		
11 Distance to railway station > 2 km		
12 Distance to bus/underground/tram > 1 km		
Accessibility by car and parking		
13 Many obstacles; traffic congestion		
14 Distance to parking sites > 250 m.		
15 <1 parking space/100 m2 road surface		
CULTURAL		
Tone of neighbourhood		
16 Situated on or near edge of town (e.g. near motorway)		
17 No other buildings in immediate vicinity		
18 Dull environment		
19 No green space in neighbourhood		
20 Area has poor reputation/image; vandalism		
21 Dangerous, noise or odour pollution (factories, trains, cars)		
LEGAL		
Urban location		
22 Noise load on façade > 50 dB (limit for offices 60dB)		
Ownership of ground		
23 Leasehold		
Total number of Yes's for Location:		
Default weighting: 5		
Location score		

BUILDING FUNCITONAL ASPECTS	YES	NO
Year of construction or renovation		
1 Building recently built (< 3 years)		
2 Recently renovated (< 3 years)		
Vacancy		
3 Some space still in use		
4 Building unoccupied < 3 years		
Features of new dwelling units		
5 (< 20 -person units (50 m2 each) can be made)		
6 Layouts suitable for local target groups cannot be implemented		
Expendability		
7 Not horizontally extendable (neighbouring buildings)		
8 No extra storey (pitched roof; insufficient load-bearing cap.)		
9 Basement cannot be built under building		
TECHNICAL		
10 Building poorly maintained/looks in poor condition		
11 Dimensions of skeleton Depth < 10 m		
12 Module of support structure < 3.60 m		
13 Distance between floors > 6.00 m		
14 Support structure (walls, pillars, floors) are in poor/hazardous condition		
15 Facade Cannot be made to blend with surroundings or module > 5.40 m		
16 Façade (or openings in façade) not adaptable		
17 Windows cannot be reused/opened		
18 Installations Impossible to install (sufficient) service ducts		
CULTURAL		
19 No character in relation to surrounding buildings		
20 Impossible to create dwellings with an identity of their own		
21 Unsafe entrance, no clear overview of situation		
LEGAL		
22 Presence of large amounts of hazardous materials		
23 Acoustic insulation of floors < 4 dB		
24 Very poor thermal insulation of outer walls and/or roof		
25 (< 10% of floor area of new units gets incident daylight)		
Requirements of Dutch building decree		
26 No lifts in building (> 4 storeys), no lifts can be installed		
27 No (emergency) stairways		
28 Distance of new unit from stairs and/or lift " 50 m		
29 Free ceiling height < 2.6m		
Total number of Yes's for Building :		
Default weighting: 3		
Building score		
TOTAL SCORE		

Total score results.

Transformation total score	Transformation class
0 - 40	Class 1: Excellent transformation
41 - 80	Class 2: Transformable
81 - 120	Class 3: Limited transformability
121 - 160	Class 4: Very poor transformability
161 - 199	Class 5: Not transformable

Appendix 3

Checklist

A. Location

Category	Possible solution
1. Legal	
1. Zoning plan	Consult local authorities; check compliance with municipal policy
2. Land ownership:leasehold	Bad for ground value appreciation; try to buy off leasehold
3. Ground contamination	Get owner to obtain clean ground declaration; negotiate lower sales price in connection with soil improvement costs
4. Air traffic law (Limits on max. height of building)	Investigate possibilities of horizontal expansion
2. Economic	
1. Asking price for offices	Boost financial yield by combining with (commercial) functions; revise design; aim at other target group
2. Rentability of homes	Improve quality/price ratio; aim at other target group
3. Other amenities needed	Improve financial feasibility by incorporating commercial functions
3. Technical	
1. Problems with air pollution/odours	Special insulation of façade(s) affected
2. Problems with noise	Explore possibilities of exemption; extra façade insulation or create double-skin façade
4. Functional/architectural	
1. Bad reputation and/or unsafe neighbourhood	Neighbourhood improvement plan with other parties, with specific objectives to attract target group
2. Parking space	Depends on target group; discuss statutory parking provisions, consider underground parking
3. Unavailability of amenities	Provide small-scale amenities in building in cooperation with other parties
4. Unavailability of public transport	Consult public transport provider; work together with other parties
5. Road access	Analyse situation; if necessary, move main entrance or provide additional entrance

B. Building

Category	Possible solution
1. Legal	
1. Asbestos present	Negotiate lower sales price or demand asbestosfree declaration from seller before purchase goes
2. Listed building (monument)	Timely consultation with Monumentenzorg (Historic Buildings Council)
3. Building legislation	Exemptions from requirements on outside space, ceiling height, access, incidence of daylight,
4. Planning permission	Timely consultation with local authorities about requirements and information to be provided
5. Fire safety	Timely consultation about requirements and information to be provided (access, escape routes)
2. Economic	
1. Acquisition building: difficult	Purchase in steps: first leasehold, then freehold; joint purchase with others
2. Large investment in start-up phase	Financial feasibility study
3. Financial/economic feasibility: Poor	Analyse expansion possibilities; combine with other (commercial) functions; apply for subsidies
4. Vacancy	Limit time building stands empty by short-term rental; take measures to deter squatters

3. Technical	
1. Analysis of structural condition	Analyse condition of building on site (with reference e.g. to design and condition of structure, finish, maintenance)
2. Climate controls	Replace or renew with requirements of dwelling units in mind; system should have individual controls for each dwelling, but possibly central supply
3. Pipes, ducts and shafts: not enough	Add more (but remember to ensure fire separation between dwellings; may be possible to lay under existing floors)
4. Water facilities: inadequate	Expand supply (remember, must have individual controls and individual meters)
5. Electricity facilities: inadequate	Expand (remember, must have individual controls and meters, central antenna system or cable, phone)
6. Sound insulation of floors	Increase isolation by adding extra floor (concrete or floating) and/or insulating ceilings
7. Poor heat insulation of the facade	Extra insulation on outside of façade or inside (in protected monuments)
8. Poor heat insulation of openings in the facade	Replace by double glazing; double window frame; double-skin façade (inside and outside)
9. Poor heat insulation in the roof	Insulate existing roof (inside or outside); replace by new roof; combine with adding extra storeys
10. Dampness present	Analyse causes (structural damp, leakage, rising damp, condensation)
11. Joints in poor condition	Clear façade and repoint in part or completely
12. Daylight levels	Use central corridors, extra internal spaces, oriel windows or bigger new windows to give more light
13. Sunbathing area	Use central corridors, extra internal spaces, oriel windows or bigger new windows to give more light
14. State of supporting structures	Renovation (may need extra reinforcement, shotcrete, adhesive reinforcement)
15. Foundation reinforcement	Renovation (may need additional piles - steel piles, jack piles or pulse-driven piles)
16. Possibility of additional structures on top of building	Use light steel and/or wooden frame constructions for extra storeys
4. Functional/architectural	
1. Analysis of opportunities for the building	Analyse design factors and key data incl. gross/net ratios; consider expansion possibilities (adding extra storeys)
2. Improving recognition of the building	Install new, more striking façade (or parts of façade); add balconies, new, more striking
3. Office too shallow	Modify layout of dwelling units; increase depth by adding new façade or foundation; external gallery
4. Office too width	Modify layout of dwelling units; create interior courtyard to let in more daylight; centralise access
5. Drawing up maps/infill plans	
6. No basement available	Add basement (if foundation and access requirements allow this)
7. High floor levels	Create light mezzanine floors with light partition walls
8. Windows do not open	Replace (some of) the windows that cannot be opened, up to complete façade renovation
9. No possibility connection new inner walls terminals on the façade walls	Connect walls to (glass) panels, up to complete façade renovation
10. No outdoor area	Target-group-dependent; prefab (French) balconies; recess (part of) façade; roof gardens; inner courtyard with garden
11. Building entrance: poor recognizability	Add e.g. canopy to increase impact, or move to other position
12. Lifts and stairs	New lifts and/or stairs in building (e.g. in protected monument) or on outside wall
13. Accessibility	Analyse different access possibilities (entrance hall, gallery, central corridor, central access)
14. Inner walls	Modify existing internal walls or add new ones (bearing need for future flexibility in mind)
15. Wet areas	Give concrete or tiled floors waterproof finish; use prefab (plastic) sanitary units

Appendix 4

Attribute list generated

ATTRIBUTE LIST BASED ON SIGNIFICANT POINTS FROM DEMAND PERSPECTIVE

Location (Living environment)

10. *Representative/Character*
    - Would you like to live in a in a classical building, New façade, historical building?
    - Would you like to live in a High rise (more than 5 stories) or low rise (less than 5 stories) building?
    - Location in: City centre, Suburbs, Financial district (area with a lot of office buildings)?
11. *Facilities*
    - Distance to:
        - Shops
            - Supermarket
            - Health care, beauty and cleaning supplies
            - Clothes
        - Bars, restaurants, etc.
        - Schools
            - Elementary educational facilities
            - Libraries
            - Universities
        - Bank/Post office
        - Medical facilities
        - Recreational facilities
            - Parks, sport center, lakes, theater, Cinema, others.
12. *Accessibility by public transport*
    - Distance to public transport
        - Walking distance
    - Distance to tram or metro
        - Biking distance
    - Distance to train station
        - Biking distance
13. *Accessibility by car*
    - Distance to motorway
    - Traffic though flow
    - Parking opportunities
        - Parking lot in the building
        - Distance to parking lot outside the building
        - Size of parking lot

Building (Dwellings)

1. *Type of house*
    - Apartment building (residential only)
    - Mixed-use building
    - Including gym or recreational rooms? (serviced apartment)
2. *Entrance*
    - Would you like to have a lobby or no lobby?
3. *Size of home*
    - Number of rooms

- Living room
- Kitchen
- Bedrooms
- Sanitary space
- Storage space

4. *Layout of the home*
    - Studio
    - Living area and 1 bedroom
    - Living area and 2 bedrooms
5. *Level of facilities*
    - Laundry common room or not (inside apartment)
6. *Outside space*
    - Balcony or no balcony?
    - Roof terrace?
    - Community green area in building
7. *View out and view in*
    - Big windows with big amount of light or normal size windows?
8. *Environmental factor*
    - Heating
        - Heating by radiator or warm air?
    - Ventilation
        - Natural or mechanical (air conditioning)
    - Noise level
    - Sun and daylight
        - Big windows with big amount of light or normal size windows?
    - Energy usage
        - Green building (Energy efficient)? Or normal energy use?
        -
    - Material usage
9. *General conditions*
    - Accessibility
        - Bike storage?
    - Safety
        - Private security?
    - Alterability
    - Adequate management
        -
10. *Costs*
    - Purchase or renting price
        - Renting price (700,900, above 1000 euros)
    - Additional costs

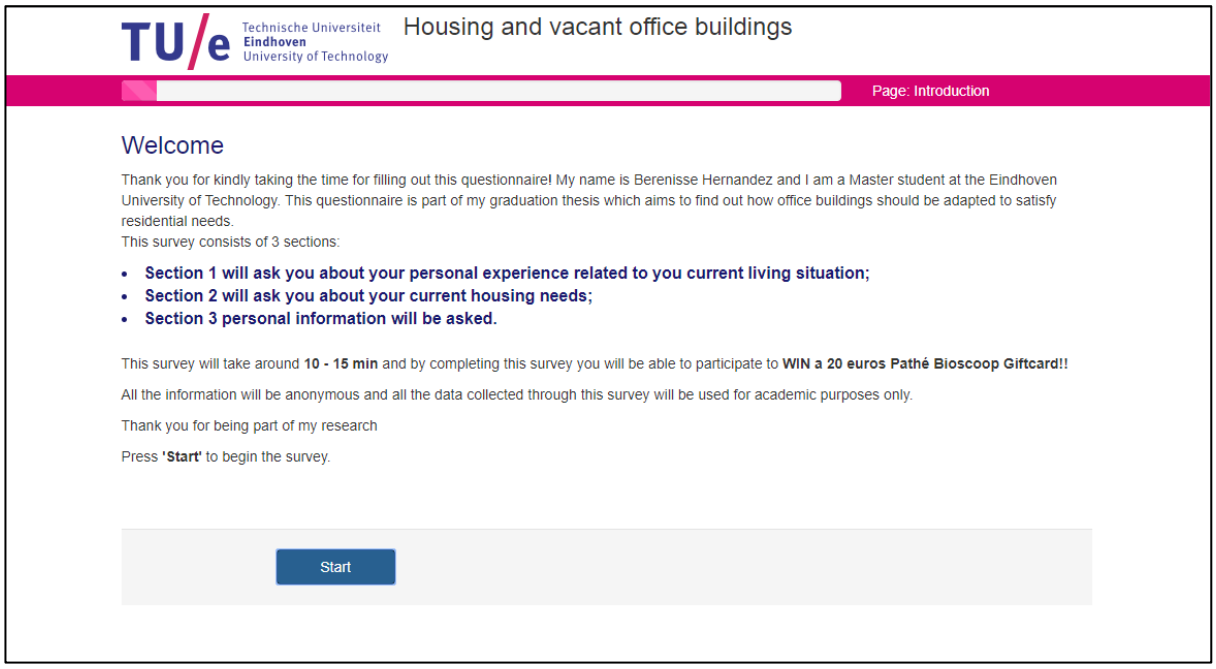
Appendix 5

Attributes and attribute levels

	Attribute	Level	Label	Description
New or can be changed				
1	Rent	0	a. 1100 euros	Base rent price, Service costs not included.
		1	b. 900 euros	
		2	c. 700 euros	
2	Type of Apartment	0	a. Appartment with 1 bedroom	Apartment with 1 bedroom or 2 bedrooms. Studio includes: Bedroom, kitchen and living room in the same space (no divisions).
		1	b. Appartment with 2 bedrooms	
		2	c. Studio appartment	
3	Building use	0	a. Serviced Appartment (building including fitness center and/or	**Mixed-use building:** Blends residential and comercial uses. (Ex. Appartment building with Supermarket, or small business on ground level). **Serviced Apartment:** Provides amenities like: fitness center and/or recreational room (room used for a variety of purposes, such as games room or hosting reunions). **Residential Only:** A building used for only for dwelling.
		1	b. Mixed-use building	
		2	c. Residential only	
4	Outdoor space	0	a. Balcony	Type of outdoor space.
		1	b. Roof terrace	
		2	c. No outdoor space	
5	Walkability in the Neighborhood	0	a. High	A Neighborhood is considerate walkable when is capable of being traveled or covered by walking. and it can be measured by the distance radious of services such as: supermarkets, basic schools, parks and restaurants. The walkability level of a Neighborhood is considered: **High:** When services are located within 800m radious. **Medium:** When services are located between 800m and 1.5 km radious.
		1	b. Medium	
		2	c. Low	
Fixed attributes				
6	Distance to city centre	0	a. Within city centrum	Location of building in relation with city centre.
		1	c. 7 min by bike	
		2	c. 15 min by bike	
7	Distance to main activity	0	a. 6 min by bike	Distance to main activity point: such as worklocation or study institution.
		1	b. 12 min by bike	
		2	c. 18 min by bike	
8	Distance to public transport	0	a. 3 min walking	Distance to nearest public transport (Ex. bus stop, train station, tram if applicable).
		1	b. 5 min walking	
		2	c. 7 min walking	
9	Façade	0	a. Heritage building	**Heritage building:** a building of historic, aesthetic, architectural or cultural significance. **Conventional building:** A building that its architectural style resembles any other building in the area, nothing special. **Modern building**: A building with a modern architectural style.
		1	b. Modern building	
		2	c. Conventional building facade	
10	Height	0	a. High rise Building	**A low-rise** is a building that is only a few stories tall, max 4 stories high. **Mid-rise** is a building between 4 and 7 stories. **High rise** Building usually is higher than 23 m or about 8 or more stories.
		1	b. Mid-rise Building	
		2	c. Low rise Building	

Appendix 6

Questionnaire



Housing and vacant office buildings

Page: Introduction

Welcome

Thank you for kindly taking the time for filling out this questionnaire! My name is Berenisse Hernandez and I am a Master student at the Eindhoven University of Technology. This questionnaire is part of my graduation thesis which aims to find out how office buildings should be adapted to satisfy residential needs.
This survey consists of 3 sections:

- **Section 1 will ask you about your personal experience related to you current living situation;**
- **Section 2 will ask you about your current housing needs;**
- **Section 3 personal information will be asked.**

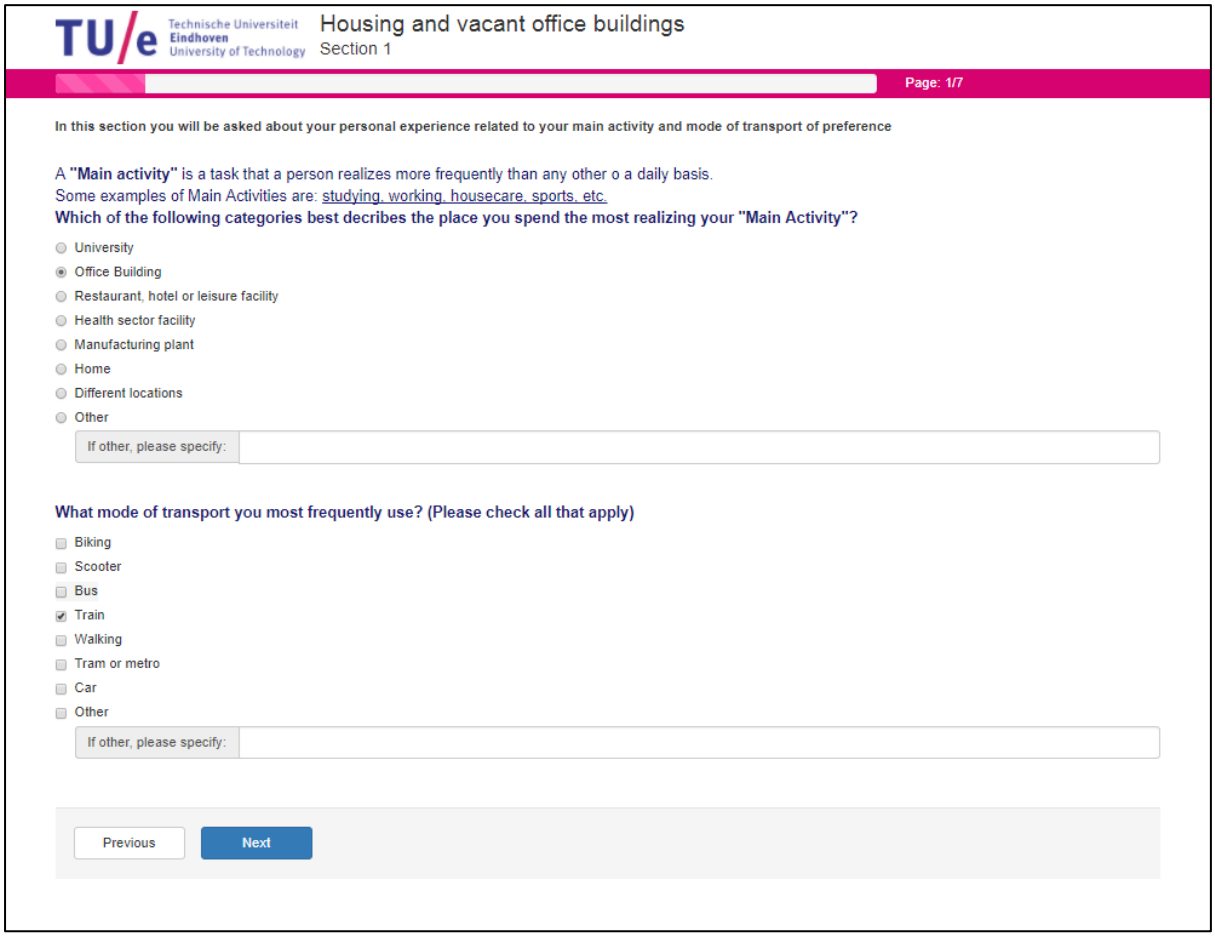
This survey will take around **10 - 15 min** and by completing this survey you will be able to participate to **WIN a 20 euros Pathé Bioscoop Giftcard!!**

All the information will be anonymous and all the data collected through this survey will be used for academic purposes only.

Thank you for being part of my research

Press **'Start'** to begin the survey.

Start



Housing and vacant office buildings
Section 1

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In this section you will be asked about your personal experience related to your main activity and mode of transport of preference

A **"Main activity"** is a task that a person realizes more frequently than any other o a daily basis.
Some examples of Main Activities are: studying, working, housecare, sports, etc.
Which of the following categories best decribes the place you spend the most realizing your "Main Activity"?

- ○ University
- ◉ Office Building
- ○ Restaurant, hotel or leisure facility
- ○ Health sector facility
- ○ Manufacturing plant
- ○ Home
- ○ Different locations
- ○ Other

If other, please specify:

What mode of transport you most frequently use? (Please check all that apply)

- ☐ Biking
- ☐ Scooter
- ☐ Bus
- ☑ Train
- ☐ Walking
- ☐ Tram or metro
- ☐ Car
- ☐ Other

If other, please specify:

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Housing and vacant office buildings

Section 1

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In this section you will be asked about your personal experience related to your current living condition and household composition.

What is your household composition?

- [x] One person household
- [ ] living with roommates
- [ ] Living with parents
- [x] living with partner
- [ ] living with partner and children
- [ ] Other

If other, please specify:

In what type of house do you live?

Examples below:

- [ ] Apartment or studio
- [x] Townhouse
- [ ] Semi-detached house
- [ ] Single family house (detached home)
- [ ] Residential unit with shared kitchen or bathroom (with roommates)
- [ ] Other

If other, please specify:

Examples

Apartment	Townhouse	Semi-detached home	Single Family House
			

Do you or any member of your household own or rent this property?

- [ ] Me and/or my partner owns the property
- [ ] Other member of the household owns the property
- [x] Me and my roommates own the property
- [ ] Me and my Roommates rent the property
- [ ] Me and/or my partner rents the property
- [ ] Other member of the household rent the property
- [ ] Other

If other, please specify:

If you had to rent a place to live, would you rather..?

- [ ] Rent a furnished apartment
- [x] Rent an unfurnished apartment
- [ ] Semi-furnished apartment or "Gestoffeerd" *
- [ ] Any option
- [ ] Other

If other, please specify:

***Semi-furnished apartment or "Gestoffeerd"**: Unfurnished but includes flooring, curtains, ceiling lights, kitchen appliances.

How important the Energy Label* is for you when looking for an apartment to rent?

- [x] Not at all important
- [ ] Somewhat important
- [ ] Important
- [ ] Very important
- [ ] Extremely important

* **Energy label:** By means of a rating (from A to G), the label provides an indication of the home's energy efficiency.

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Housing and vacant office buildings

Section 2

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Assume you are currently looking for an apartment to RENT.

In the following scenarios you will be shown a table with 2 options of apartments, from these you will be required to select the one you find more atractive.
In case you don't find any of the options atractive, you will be able to select the option "None of the options".

The variables will be divided in:

- Building amenities
- location atributes and building type.

Some important aspects you must consider before making your choice:

- In this exercice you will **Assume** you are currently looking an apartment to rent. Therefore all options will only include rental apartments.
- The options of apartments given are incorporated into vacant office buildings or industrial buildings that went through renovation and conversion into housing.
- The rental price is the base rental price (Not including service cost).

Please Click on **"Next"** to see an example.

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Housing and vacant office buildings

Section 2

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Below you will find an explanation of different options for "BUILDING AMENITIES"

	Variable	Description
	Rent	Base rent price, Service costs not included
	Bedrooms	Apartments options can have 1 bedroom or 2 bedrooms. Studio includes: Bedroom, kitchen and living room in the same space (no divisions).
	Building use	• **Mixed-use building:** Blends residential and comercial uses. (Ex. Appartment building with Supermarket, or small business on ground level). • **Serviced Appartment:** Provides amenities like: fitness center and/or recreational room (room used for a variety of purposes, such as games room or hosting reunions). • **Residential Only:** A building used for only for dwelling
	Outdoor space	Type of outdoor space
	Walkability of the Neighborhood	A Neighborhood is considerate walkable when is capable of being traveled or covered by walking. and it can be measured by the distance radious of services such as: supermarkets, basic schools, parks and restaurants. The walkability level of a Neighborhood is considered: • **High:** When services are located within 800m radious. • **Medium:** When services are located between 800m and 1.5 km radious. • **Low:** When services are located at more than 1.5 km radious.

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Below you find the explanation of different options of "LOCATIONS AND BUILDING TYPE".

	Variable	Description
	Distance to city centre	Location of the building in relation with city centre.
	Distance to main activity	Distance to main activity point such as work location or study institution.
	Distance to public transport	Distance to nearest public transport (For example bus stop, train station, tram or metro if applicable).
	Facade (see below)	• **Heritage building**: a building of historic, architectural, or cultural significance. • **Modern building**: A building with a modern architectural style. • **Conventional building**: A building that its architectural style resembles any other building in the area, nothing special.
	Height	• **High rise** Building usually is higher than 23 m or about 8 or more stories. • **Mid-rise** is a building between 4 and 7 stories. • **Low-rise** is a building that is maximum 4 stories high.

Types of facades

Conventional building	Modern building		Heritage building
			

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Housing and vacant office buildings
Section 2

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This is a trial question!

The following 9 questions will show different apartment alternatives. Assuming you are required to rent an apartment

- First, select at the end of the table the option you find **most attractive**. If you are not satisfied with any of the options please mark the option "None of the options".
- Next, choose if you **want to rent and live** in the chosen apartment. If you have chosen for "None of the options", please mark "No".

NOTE: To display the definition of a variable, place the cursor on the variable name.

Example choice situation

Specification		Option A	Option B	None of the options
Building Amenities	*Base Rent*	1100 euros	1100 euros	
	Type of apartment	1 bedroom apartment	1 bedroom apartment	
	Building use	Residential only	Mix-use building	
	Type of outdoor space	Balcony	Roof terrace	
	Walkability	Low	High	
Location and building type	*Distance to city centre*	15 min by bike	7 min by bike	
	Distance to main activity	6 min by bike	12 min by bike	
	Distance to nearest public transport	3 minutes walking	7 min walking	
	Facade	Heritage building	Modern Building	
	Height	High rise	Low rise	
What option do you find most attractive?		◉	○	○

Would you live in the chosen option?

Yes	No
◉	○

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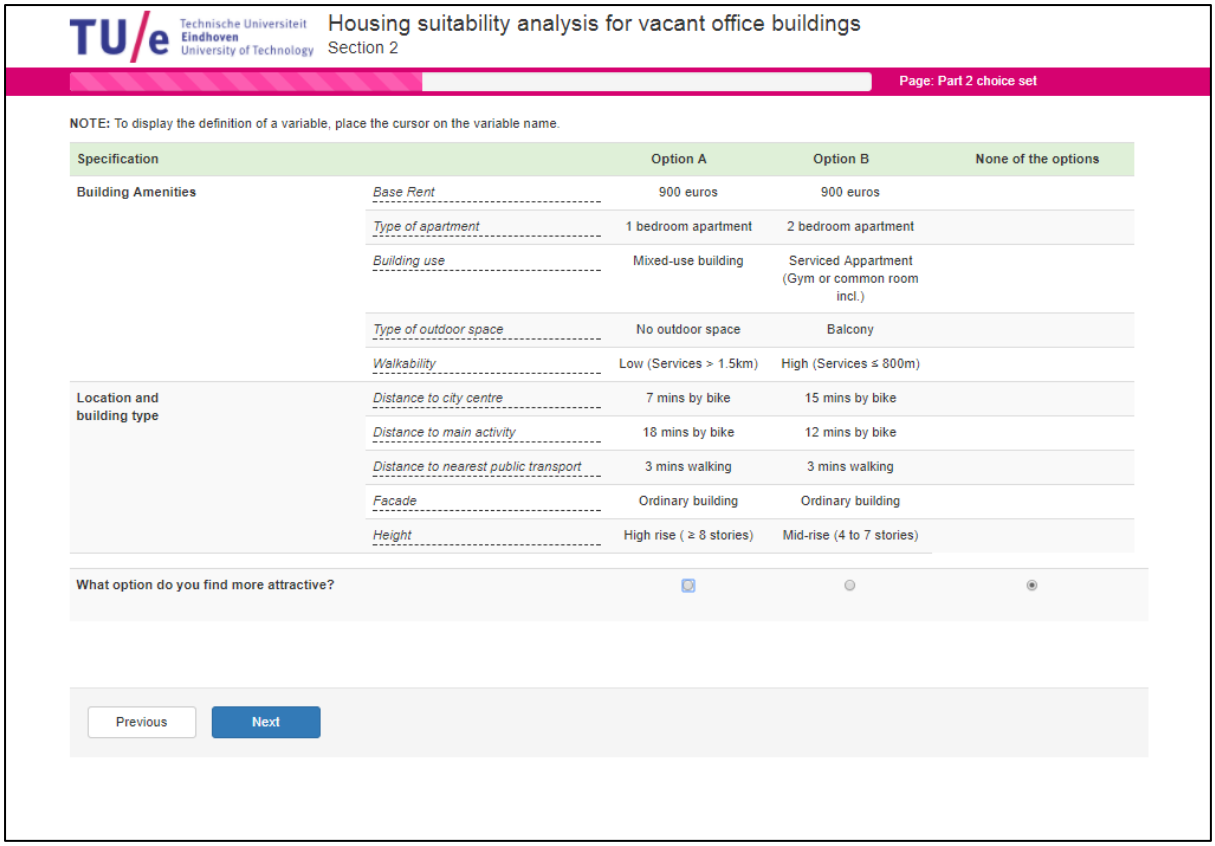

Technische Universiteit Eindhoven University of Technology

Housing suitability analysis for vacant office buildings

Section 2

Page: Part 2 choice set

NOTE: To display the definition of a variable, place the cursor on the variable name.

Specification		Option A	Option B	None of the options
Building Amenities	*Base Rent*	900 euros	900 euros	
	Type of apartment	1 bedroom apartment	2 bedroom apartment	
	Building use	Mixed-use building	Serviced Appartment (Gym or common room incl.)	
	Type of outdoor space	No outdoor space	Balcony	
	Walkability	Low (Services > 1.5km)	High (Services ≤ 800m)	
Location and building type	*Distance to city centre*	7 mins by bike	15 mins by bike	
	Distance to main activity	18 mins by bike	12 mins by bike	
	Distance to nearest public transport	3 mins walking	3 mins walking	
	Facade	Ordinary building	Ordinary building	
	Height	High rise (≥ 8 stories)	Mid-rise (4 to 7 stories)	
What option do you find more attractive?		○	○	◉

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Housing and vacant office buildings

Section 3

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In this section you will be asked to fill out personal information.All the information will be anonymous and all the data collected through this survey will be used for academic purposes only.

What is your gender?

- Female
- Male

What is your age?

What of the following categories best describes your status regarding your career?

- Employed
- Self-employed
- Homemaker
- Student
- Retired
- Unemployed

What is your nationality?

Make a choice

What is the highets level of education you have completed?

- Elementary education
- Secondary school
- High school degree
- Bachelor degree
- Master degree
- PhD degree

Do you have children?

- yes, I have 1 child
- yes, I have 2 children
- yes I have 3 or more children
- No

Please add the first 4 digits of your Postal code

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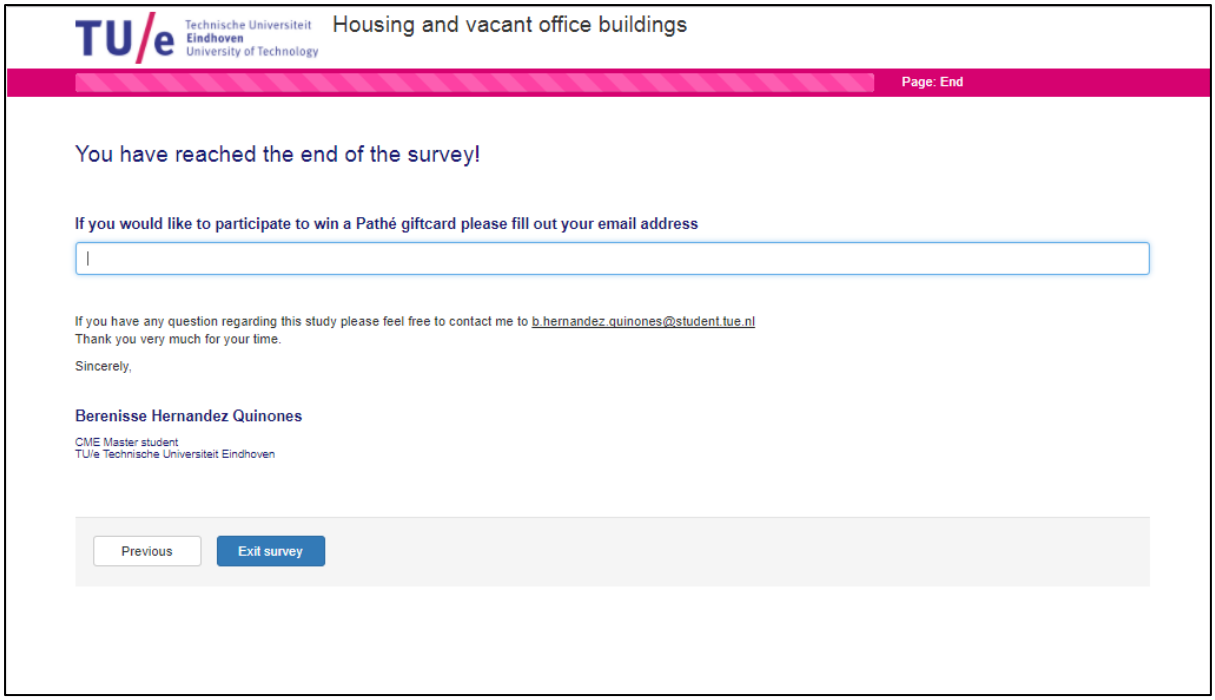

Technische Universiteit Eindhoven University of Technology
Housing and vacant office buildings
Page: End
You have reached the end of the survey!
If you would like to participate to win a Pathé giftcard please fill out your email address
If you have any question regarding this study please feel free to contact me to b.hernandez.quinones@student.tue.nl
Thank you very much for your time.
Sincerely,
Berenisse Hernandez Quinones
CME Master student
TU/e Technische Universiteit Eindhoven
Previous
Exit survey

Appendix 7

Survey Flyers

Nederlands

Win een €20 euro bioscoopkaart door het invullen van deze enquête!

Technische Universiteit Eindhoven University of Technology

Hallo, mijn naam is Berenisse Hernandez en ik ben masters student aan de Technische Universiteit Eindhoven waar doe ik een afstudeeronderzoek naar de **potentie van leegestaande gebouwen voor transformatie naar huisvesting**. De enquête is in het **Engels** en bestaat uit 3 delen en zal niet langer dan **15 min** duren om in te vullen.

https://vragen9.ddss.nl/q/housing-suitability

Onder de deelnemers die de enquête volledig invullen en hun adres gegevens achterlaten op de laaste pagina zal **een Pathé bioscoopkaart van €20,- worden verloot.**

Alvast bedank voor het deelnemen aan dit onderzoek,

Berenisse Hernandez Quinones

English

Win a €20 euro cinema gift card by filling in this survey!

Technische Universiteit Eindhoven University of Technology

Hello, my name is Berenisse Hernandez and I am master student at the Technical University of Eindhoven where I am doing a research project to **find the potential of vacant buildings to be converted into housing projects.** The questionnaire will be in **English** and consists of 3 parts and will not take longer than **15 minutes** to complete.

https://vragen9.ddss.nl/q/housing-suitability

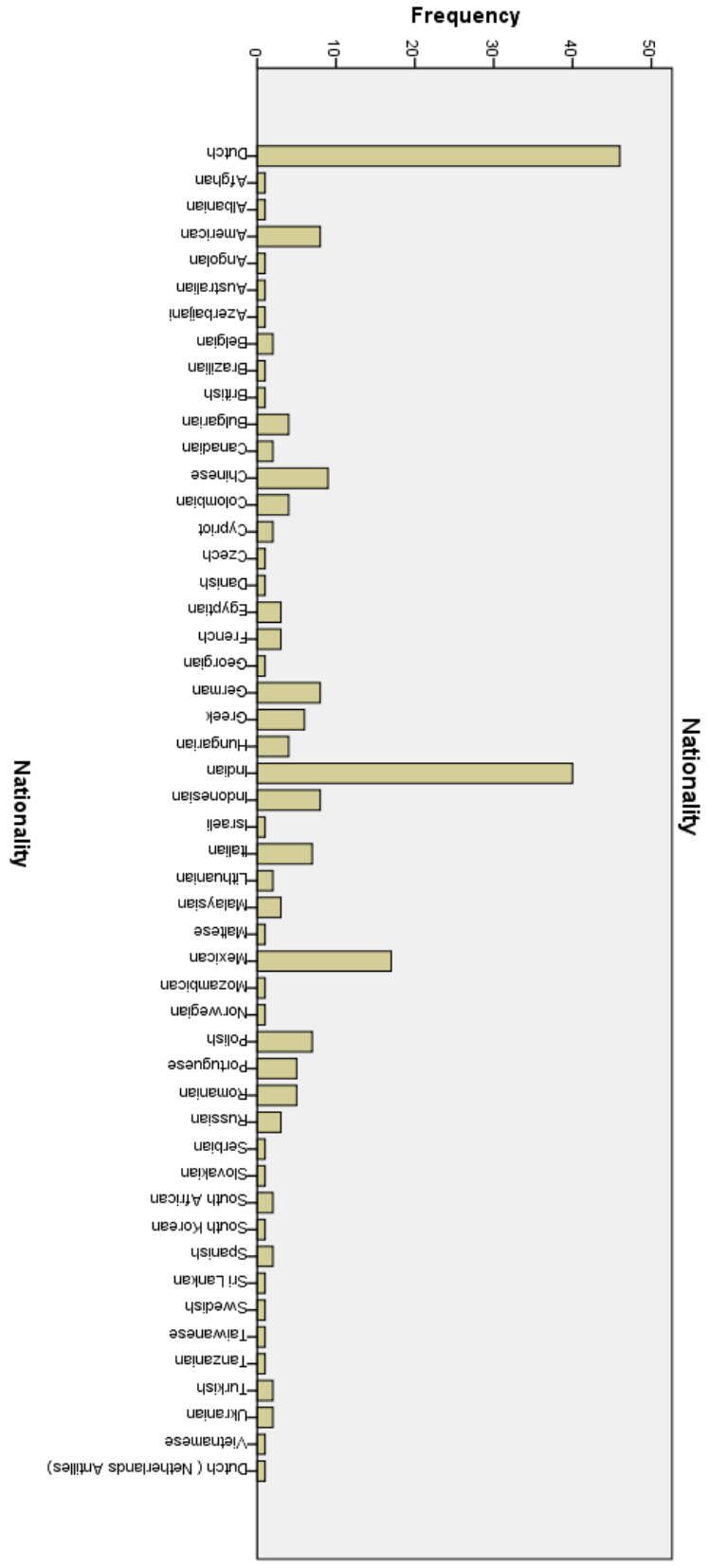
A **Pathé Cinema Gift card € 20,-** will be raffled among the participants who completely fill out the survey and leave their email address information on the last page.

Thank you for participating in this study,

Berenisse Hernandez Quinones

Appendix 8

Nationality respondent's tables



Appendix 9

MNL categories models

Variable	General	Nationality (Dutch)	Nationality (non-Dutch)	Students	Non-Students	Household (1 person)	Household (2 person)	Household (3 or more)	Living with Children	Ages 18-24	Ages 25-31	Ages 32+
ICONST|	1.66633 ***	1.408 ***	1.73648 ***	1.81926 ***	1.50423 ***	2.06991 ***	1.41426 ***	1.68519 ***	1.50874 ***	1.71041 ***	1.42085 ***	1.76524 ***
3 min walking to PT	0.05599	-0.03759	0.08169	0.05078	0.03957	-0.06096	0.09131	0.10284	0.19268	0.10608	0.01919	0.05835
5 min walking to PT	-0.03158	-0.04201	-0.03366	-0.0371	-0.01761	0.10165	0.047	-0.10301	-0.30154 *	-0.09333	0.02177	-0.02545
7 min walking to PT	-0.02441	0.0796	-0.04803	-0.01368	-0.02196	-0.04069	-0.13831	0.00017	0.10886	-0.01275	-0.04096	-0.0329
700 euros	0.65223 ***	0.87508 ***	0.61268 ***	0.85415 ***	0.38498 ***	0.76485 ***	0.62325 ***	0.79222 ***	0.05458	0.89884 ***	0.2663 **	0.70107 ***
900 euros	0.03548	-0.12535	0.07343	0.06269	0.01281	-0.00025	0.0645	0.12204	0.05099	-0.04556	-0.02318	0.11347
1100 euros	-0.68771	-0.74973	-0.68611	-0.91684	-0.39779	-0.7646	-0.68775	-0.91426	-0.10557	-0.85328	-0.24312	-0.81454
Ordinary	-0.06586	-0.2191 *	-0.03345	-0.04935	-0.05285	-0.05821	-0.14292	-0.0712	0.19889	-0.00635	-0.03349	-0.1348 *
Heritage	0.04466	0.0076	0.05332	0.09097	-0.02164	0.05645	0.01615	0.13128	-0.14399	0.03212	-0.0534	0.08925
Modern	0.0212	0.2115	-0.01987	-0.04162	0.07449	0.00176	0.12677	-0.06008	-0.0549	-0.02577	0.08689	0.04555
1 bedroom	-0.07686	-0.11	-0.06812	-0.11108 *	-0.01049	-0.09555	0.01361	-0.12268	-0.07927	-0.13255	-0.10407	-0.01439
2 bedrooms	0.58159 ***	0.7866 ***	0.53964 ***	0.48343 ***	0.74743 ***	0.36995 ***	0.70935 ***	0.70254 ***	0.56937 ***	0.58738 ***	0.78628 ***	0.49709 ***
Studio	-0.50473	-0.6766	-0.47152	-0.37235	-0.73694	-0.2744	-0.72296	-0.57986	-0.4901	-0.45483	-0.68221	-0.4827
Balcony	0.25362 ***	0.35123 ***	0.22753 ***	0.26451 ***	0.25364 ***	0.20084 **	0.09365	0.36585 ***	0.4468 **	0.32352 ***	0.31929 ***	0.1968 **
Roof terrace	0.05341	0.07532	0.05277	0.0037	0.10676	0.05192	0.16921 *	0.01669	-0.07032	-0.09459	-0.02319	0.19939 ***
No outdoor space	-0.30703	-0.42655	-0.2803	-0.26821	-0.3604	-0.25276	-0.26286	-0.38254	-0.37648	-0.22893	-0.2961	-0.39619
6 min by bike to MA	0.07269	0.07832	0.07205	0.16283 **	-0.05417	0.01957	-0.11877	0.30927 ***	-0.09471	0.16165 *	-0.04994	0.07496
12 min by bike to MA	0.1332 **	0.12715	0.13416 **	0.10989	0.17549 **	0.20453 *	0.22148 **	0.00442	0.24894	-0.02965	0.05987	0.31031 ***
18 min by bike to MA	-0.20589	-0.20547	-0.20621	-0.27272	-0.12132	-0.2241	-0.10271	-0.31369	-0.15423	-0.132	-0.00993	-0.38527
Residential only	0.03478	0.13171	0.01123	-0.02123	0.15371 **	-0.03742	-0.03409	0.10756	0.24803	0.18774 **	0.02747	-0.06182
Serviced apartment	0.20505 ***	0.35171 ***	0.18569 ***	0.27096 ***	0.11407	0.19638 **	0.14165	0.25374 ***	0.37225 **	0.17016 **	0.26057 **	0.22123 ***
Mixed-use	-0.23983	-0.48342	-0.19692	-0.24973	-0.26778	-0.15896	-0.10756	-0.3613	-0.62028	-0.3579	-0.28804	-0.15941
Low walkability	-0.24943 ***	-0.17695	-0.27279 ***	-0.26986 ***	-0.20682 ***	-0.25959 **	-0.27305 ***	-0.17883 *	-0.43886 **	-0.34556 ***	-0.40317 ***	-0.13004 *
Medium walkability	0.12674 **	0.14437	0.12427 **	0.08784	0.16708 **	0.02099	0.18558 *	0.08311	0.42565 **	0.15441	0.23795 **	0.06844
High walkability	0.12269	0.03258	0.14852	0.18202	0.03974	0.2386	0.08747	0.09572	0.01321	0.19115	0.16522	0.0616
Low rise	-0.03975	0.02373	-0.05335	-0.03002	-0.07985	-0.08601	0.08049	-0.07118	-0.16201	0.01764	0.07943	-0.14775 **
Medium rise	0.03299	0.1359	0.00607	-0.01484	0.14633 *	0.09465	0.06149	-0.05802	0.27603	0.01652	0.14202	0.00575
High rise	0.00676	-0.15963	0.04728	0.04486	-0.06648	-0.00864	-0.14198	0.1292	-0.11402	-0.03416	-0.22145	0.142
within city centre	0.24322 ***	0.38086 ***	0.21538 ***	0.21219 ***	0.3049 ***	0.19171 **	0.28558 ***	0.33253 ***	0.11887	0.23884 ***	0.26762 **	0.24442 ***
7 min by bike to city centre	0.01089	0.09163	-0.00374	0.03857	-0.00522	0.11935	-0.02947	-0.00232	-0.17428	0.08157	0.10386	-0.06212
15 min by bike to city centre	-0.25411	-0.47249	-0.21164	-0.25076	-0.29968	-0.31106	-0.25611	-0.33021	0.05541	-0.32041	-0.37148	-0.1823
Responents	230	46	184	133	97	61	65	83	21	79	104	47
LLm	-1295.34	-312.16	-1295.34	-883.33	-700.87	-412.09	-458.25	-542.24	-148.72	-527.89	-704.15	-344.74
LLc	-1511.51	-394.24	-1511.51	-1083.05	-822.20	-482.40	-555.00	-688.46	-177.96	-651.66	-852.70	-402.10
LL0	-4766.35	-953.27	-3813.08	-2756.19	-2010.16	-1264.12	-1347.01	-1720.03	-435.19	-1637.14	-2155.22	-973.99
McFadden p2	0.2718	0.3275	0.3397	0.3205	0.3487	0.3260	0.3402	0.3153	0.3417	0.3224	0.3267	0.3539

Appendix 10

MNL subcategories

	Internationals 1 person HH	Internationals 2 person HH	Internationals 3+ person HH	Students 1 person HH	Students 3+ person HH
Variable					
ICONST|	2.2639 ***	1.46148 ***	1.64328 ***	2.1792 ***	1.79938 ***
3 min walking to PT	-0.03332	0.13807	0.12491	0.01691	0.07796
5 min walking to PT	0.09768	0.02683	-0.10017	0.03726	-0.09805
7 min walking to PT	-0.06436	-0.1649	-0.02474	-0.05417	0.02009
700 euros	0.87266 ***	0.57693 ***	0.68924 ***	0.89299 ***	0.9124 ***
900 euros	0.03396	0.18342	0.11517	0.16536	0.07755
1100 euros	-0.90662	-0.76035	-0.80441	-1.05835	-0.98995
Ordinary	-0.02892	-0.05382	-0.04946	0.07195	-0.12793
Heritage	0.06794	0.0378	0.14002	0.09176	0.15488
Modern	-0.03902	0.01602	-0.09056	-0.16371	-0.02695
1 bedroom	-0.13341	0.02777	-0.11245	-0.13251	-0.14544
2 bedrooms	0.29628 ***	0.66524 ***	0.74085 ***	0.187	0.62686 ***
Studio	-0.16287	-0.69301	-0.6284	-0.05449	-0.48142
Balcony	0.18895 *	-0.04477	0.39377 ***	0.19213	0.38424 ***
Roof terrace	-0.0363	0.19488 *	0.0734	-0.0709	-0.05126
No outdoor space	-0.15265	-0.15011	-0.46717	-0.12123	-0.33298
6 min by bike to MA	-0.01853	-0.10056	0.35991 ***	-0.06462	0.35002 ***
12 min by bike to MA	0.27916 **	0.23224 *	-0.06692	0.37924 **	-0.04492
18 min by bike to MA	-0.26063	-0.13168	-0.29299	-0.31462	-0.3051
Residential only	-0.11606	-0.10656	0.12787	-0.06163	0.0921
Serviced apartment	0.28746 ***	0.1334	0.14484	0.31358 ***	0.27375 ***
Mixed-use	-0.1714	-0.02684	-0.27271	-0.25195	-0.36585
Low walkability	-0.31363 ***	-0.3466 ***	-0.18037 *	-0.25876 **	-0.29808 ***
Medium walkability	-0.0202	0.15823	0.09639	-0.07745	0.11669
High walkability	0.33383	0.18837	0.08398	0.33621	0.18139
Low rise	-0.13792	0.06579	-0.05661	-0.16258	0.00906
Medium rise	0.08329	0.0304	-0.1263	0.08879	-0.07102
High rise	0.05463	-0.09619	0.18291	0.07379	0.06196
within city centre	0.19309 *	0.15997	0.37379 ***	0.17867	0.32492 ***
7 min by bike to city centre	0.09275	0.00942	-0.05206	0.01644	0.02484
15 min by bike to city centre	-0.28584	-0.16939	-0.32173	-0.19511	-0.34976
Responents	52	52	61	41	64
LLm	-332.9956	-368.566	-401.2082	-262.85	-406.3345
LLc	-402.4031	-440.3513	-508.08	-32107748	-523.8891
LL0	-1077.61	-1077.61	-1264.12	-849.65	-1326.29
McFadden ρ2	0.3090	0.3420	0.3174	0.3094	0.3064

Appendix 11

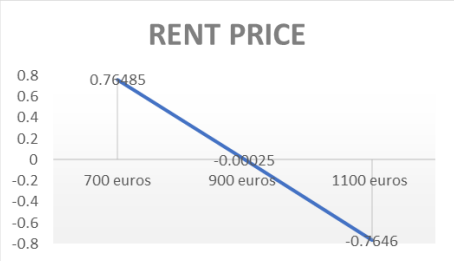
Attribute set descriptions

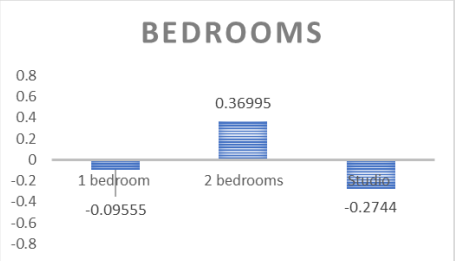
Location	Distance to main activity	Distance to public transport	Façade	Height
15 min by bike to city centre	6 min by bike	3 min walking	Heritage building	High rise Building (8 or more stories)
7 min by bike to city centre	12 min by bike	7 min walking	Modern building	Low rise Building (up to 4 stories)
Within city centre	18 min by bike	5 min walking	Conventional building facade	Mid-rise Building (Between 4 and 7 stories)
7 min by bike to city centre	12 min by bike	5 min walking	Conventional building facade	Low rise Building (up to 4 stories)
Within city centre	18 min by bike	3 min walking	Heritage building	Mid-rise Building (Between 4 and 7 stories)
15 min by bike to city centre	6 min by bike	7 min walking	Modern building	High rise Building (8 or more stories)
Within city centre	18 min by bike	7 min walking	Modern building	Mid-rise Building (Between 4 and 7 stories)
15 min by bike to city centre	6 min by bike	5 min walking	Conventional building facade	High rise Building (8 or more stories)
7 min by bike to city centre	12 min by bike	3 min walking	Heritage building	Low rise Building (up to 4 stories)
15 min by bike to city centre	12 min by bike	5 min walking	Modern building	Mid-rise Building (Between 4 and 7 stories)
7 min by bike to city centre	18 min by bike	3 min walking	Conventional building facade	High rise Building (8 or more stories)
Within city centre	6 min by bike	7 min walking	Heritage building	Low rise Building (up to 4 stories)
7 min by bike to city centre	18 min by bike	7 min walking	Heritage building	High rise Building (8 or more stories)
Within city centre	6 min by bike	5 min walking	Modern building	Low rise Building (up to 4 stories)
15 min by bike to city centre	12 min by bike	3 min walking	Conventional building facade	Mid-rise Building (Between 4 and 7 stories)
Within city centre	6 min by bike	3 min walking	Conventional building facade	Low rise Building (up to 4 stories)
15 min by bike to city centre	12 min by bike	7 min walking	Heritage building	Mid-rise Building (Between 4 and 7 stories)
7 min by bike to city centre	18 min by bike	5 min walking	Modern building	High rise Building (8 or more stories)
15 min by bike to city centre	18 min by bike	7 min walking	Conventional building facade	Low rise Building (up to 4 stories)
7 min by bike to city centre	6 min by bike	5 min walking	Heritage building	Mid-rise Building (Between 4 and 7 stories)
Within city centre	12 min by bike	3 min walking	Modern building	High rise Building (8 or more stories)
7 min by bike to city centre	6 min by bike	3 min walking	Modern building	Mid-rise Building (Between 4 and 7 stories)
Within city centre	12 min by bike	7 min walking	Conventional building facade	High rise Building (8 or more stories)
15 min by bike to city centre	18 min by bike	5 min walking	Heritage building	Low rise Building (up to 4 stories)
Within city centre	12 min by bike	5 min walking	Heritage building	High rise Building (8 or more stories)
15 min by bike to city centre	18 min by bike	3 min walking	Modern building	Low rise Building (up to 4 stories)
7 min by bike to city centre	6 min by bike	7 min walking	Conventional building facade	Mid-rise Building (Between 4 and 7 stories)

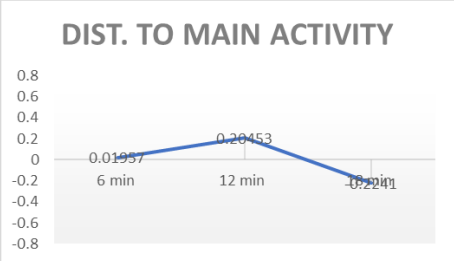
Profile number	Price	Bedrooms	Building use	Outdoor space	Walkability
1	1100 euros	Appartment with 1 bedroom	Residential only	Balcony	more of 1.5km)
2	1100 euros	Appartment with 1 bedroom	Mixed-use building	Roof terrace	within 800m)
3	1100 euros	Appartment with 1 bedroom	fitness center and/or recreational room)	No outdoor space	restaurants between 800m and 1.5km)
4	1100 euros	Appartment with 2 bedroom	Residential only	Balcony	more of 1.5km)
5	1100 euros	Appartment with 2 bedroom	Mixed-use building	Roof terrace	within 800m)
6	1100 euros	Appartment with 2 bedroom	fitness center and/or recreational room)	No outdoor space	restaurants between 800m and 1.5km)
7	1100 euros	Studio Appartment	Residential only	Balcony	more of 1.5km)
8	1100 euros	Studio Appartment	Mixed-use building	Roof terrace	within 800m)
9	1100 euros	Studio Appartment	fitness center and/or recreational room)	No outdoor space	restaurants between 800m and 1.5km)
10	900 euros	Appartment with 1 bedroom	Residential only	Roof terrace	restaurants between 800m and 1.5km)
11	900 euros	Appartment with 1 bedroom	Mixed-use building	No outdoor space	more of 1.5km)
12	900 euros	Appartment with 1 bedroom	fitness center and/or recreational room)	Balcony	within 800m)
13	900 euros	Appartment with 2 bedroom	Residential only	Roof terrace	restaurants between 800m and 1.5km)
14	900 euros	Appartment with 2 bedroom	Mixed-use building	No outdoor space	more of 1.5km)
15	900 euros	Appartment with 2 bedroom	fitness center and/or recreational room)	Balcony	within 800m)
16	900 euros	Studio Appartment	Residential only	Roof terrace	restaurants between 800m and 1.5km)
17	900 euros	Studio Appartment	Mixed-use building	No outdoor space	more of 1.5km)
18	900 euros	Studio Appartment	fitness center and/or recreational room)	Balcony	within 800m)
19	700 euros	Appartment with 1 bedroom	Residential only	No outdoor space	within 800m)
20	700 euros	Appartment with 1 bedroom	Mixed-use building	Balcony	restaurants between 800m and 1.5km)
21	700 euros	Appartment with 1 bedroom	fitness center and/or recreational room)	Roof terrace	more of 1.5km)
22	700 euros	Appartment with 2 bedroom	Residential only	No outdoor space	within 800m)
23	700 euros	Appartment with 2 bedroom	Mixed-use building	Balcony	restaurants between 800m and 1.5km)
24	700 euros	Appartment with 2 bedroom	fitness center and/or recreational room)	Roof terrace	more of 1.5km)
25	700 euros	Studio Appartment	Residential only	No outdoor space	within 800m)
26	700 euros	Studio Appartment	Mixed-use building	Balcony	restaurants between 800m and 1.5km)
27	700 euros	Studio Appartment	fitness center and/or recreational room)	Roof terrace	more of 1.5km)

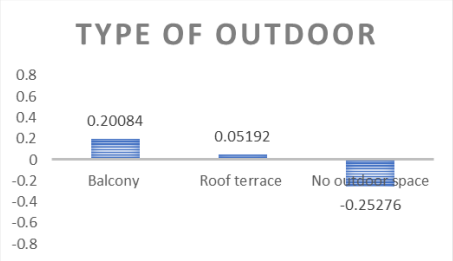
Appendix 12

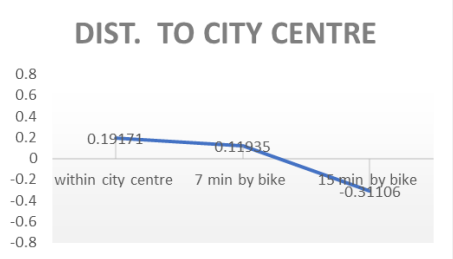
One-person household Category. Attribute level preference representation

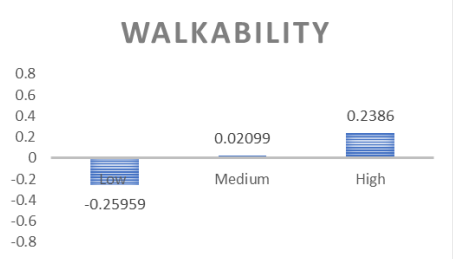


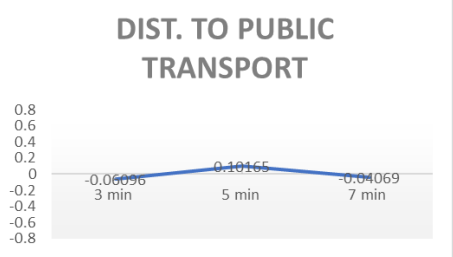


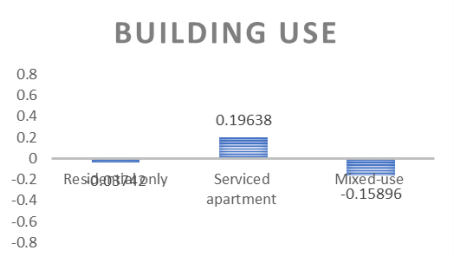


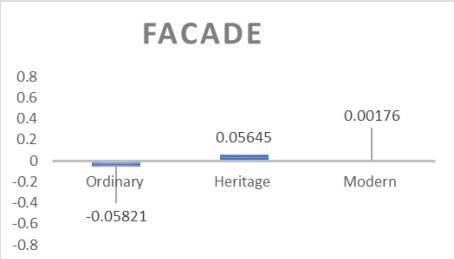


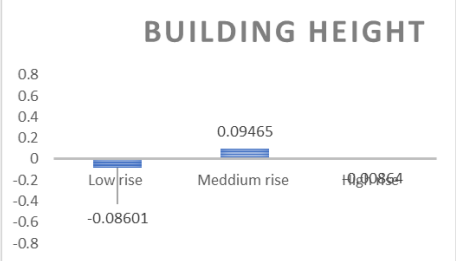




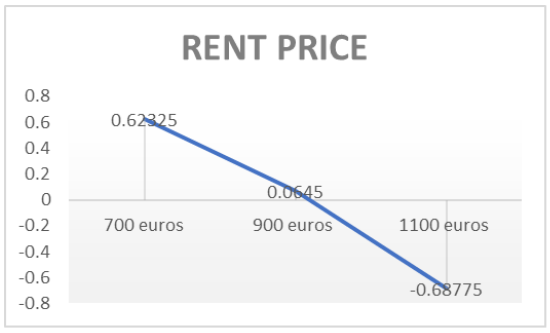


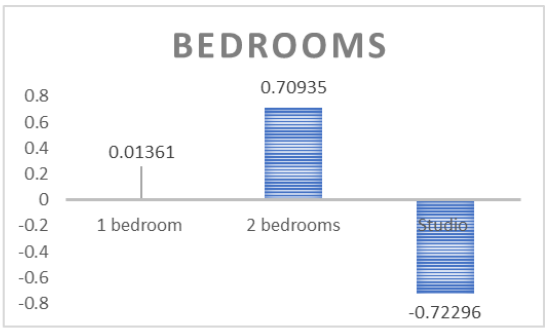


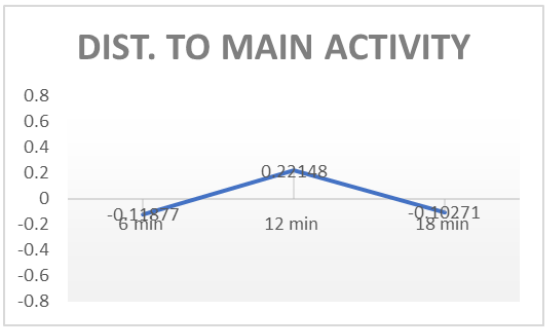


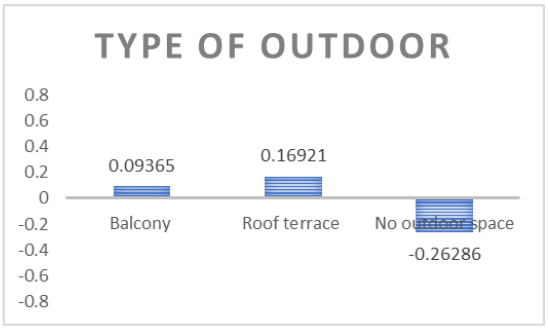


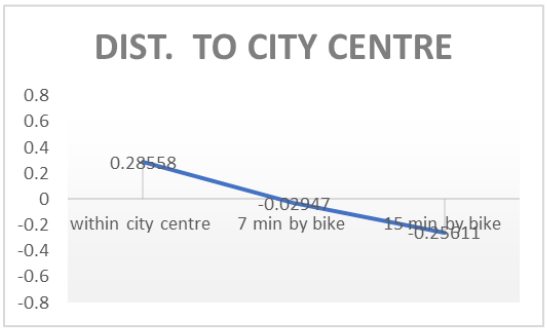
Two-person household Category. Attribute level preference representation

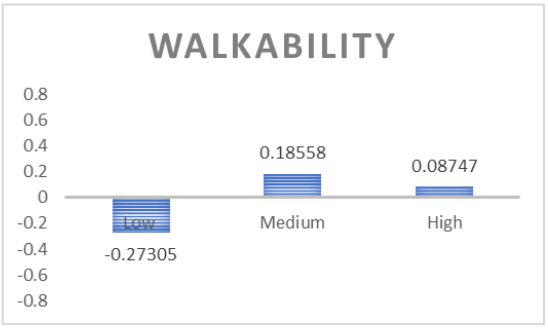


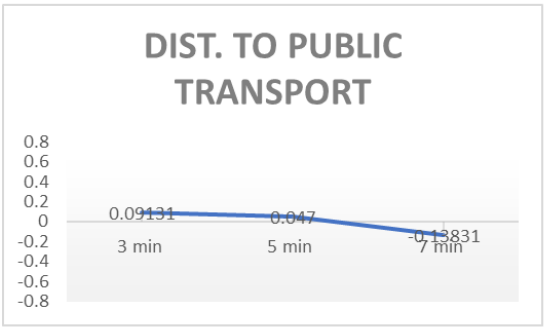


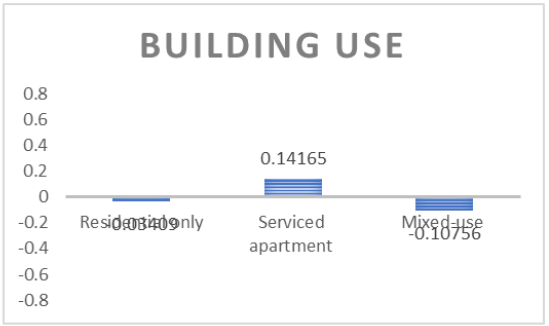


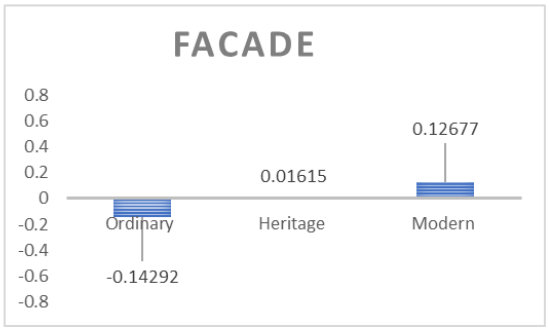




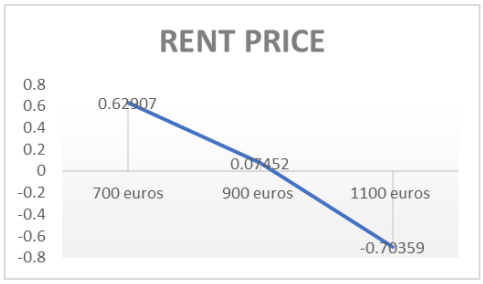


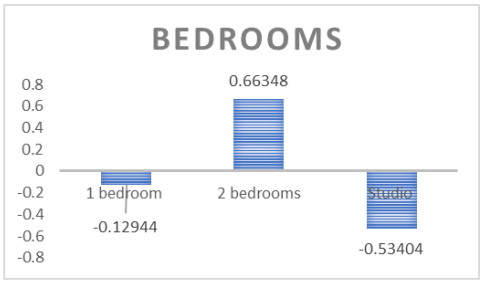


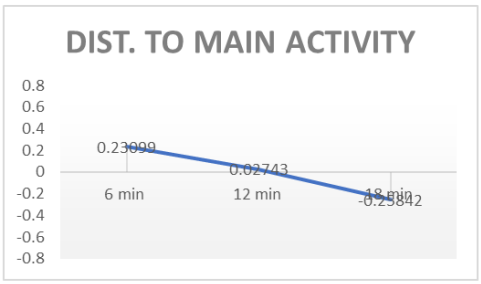


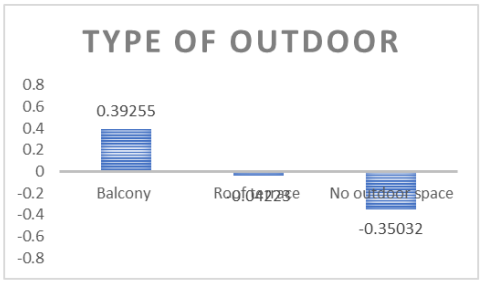


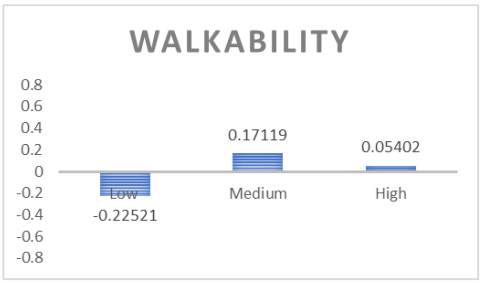
3 or more-person household Category. Attribute level preference representation

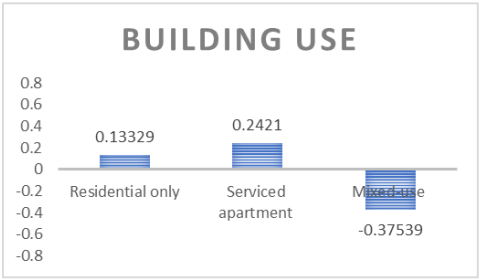


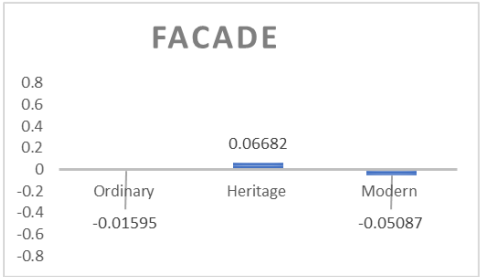






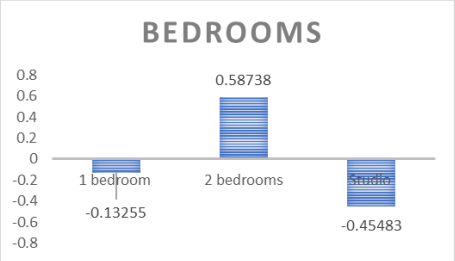


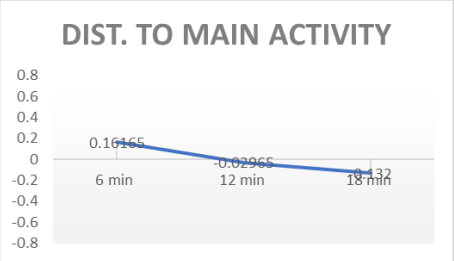


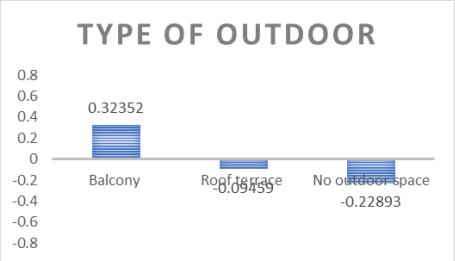


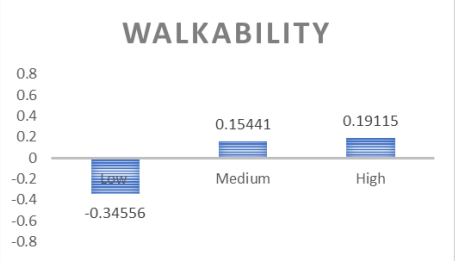
Appendix 13

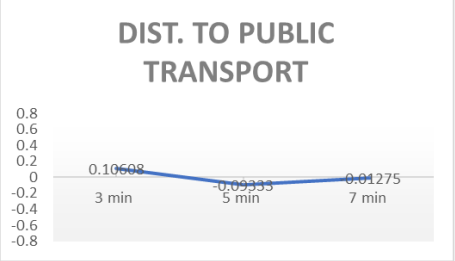
Ages 18-24 Category. Attribute level preference representation

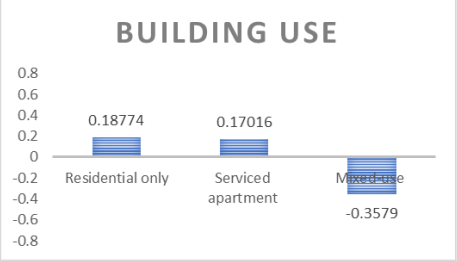


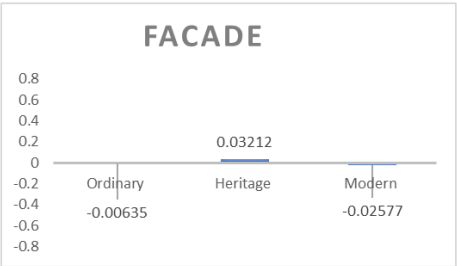




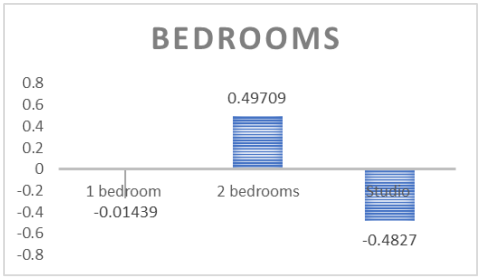


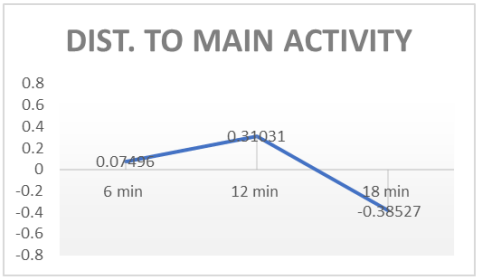


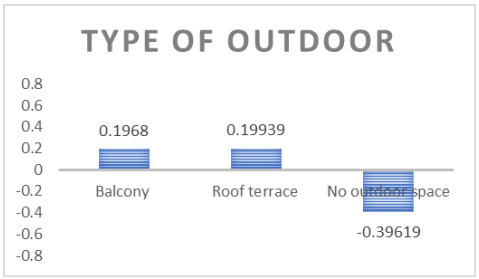


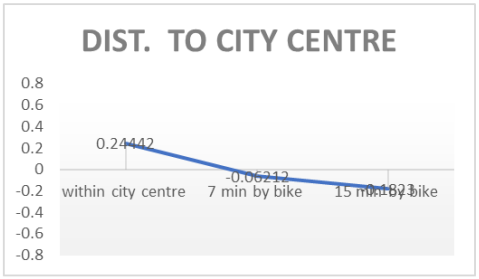


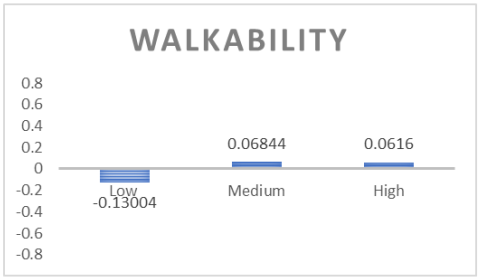
Ages 25-31 Category. Attribute level preference representation

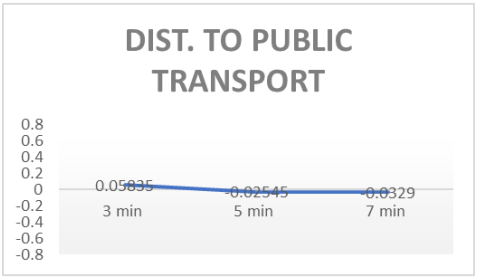


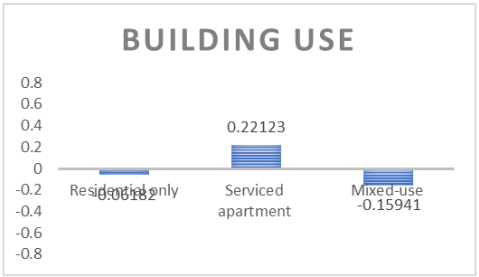


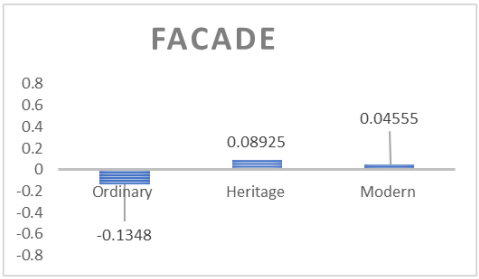


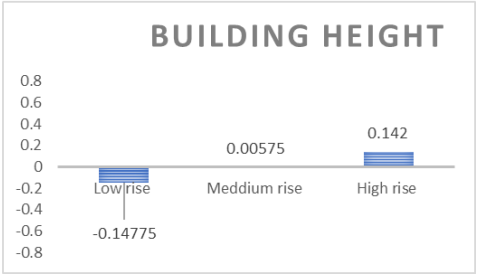




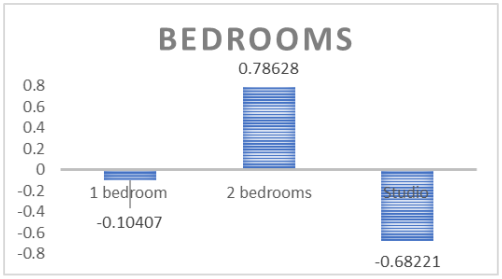


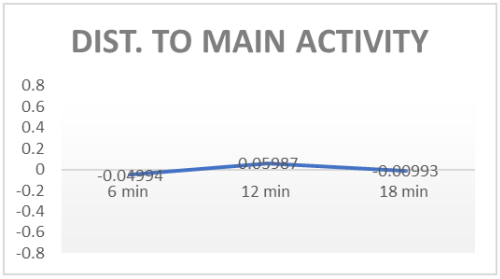


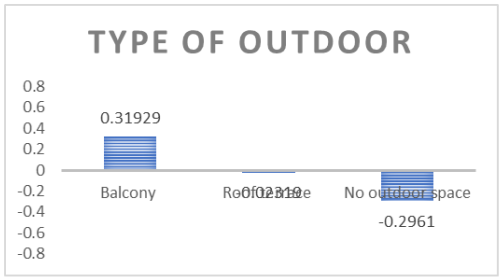


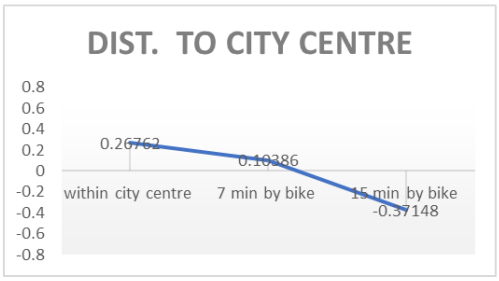


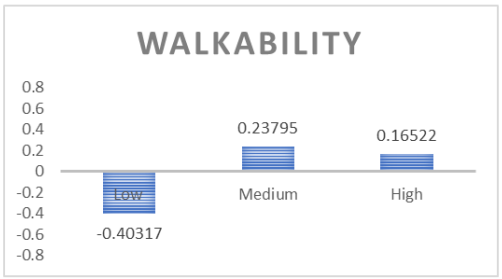
Ages 32 Category. Attribute level preference representation

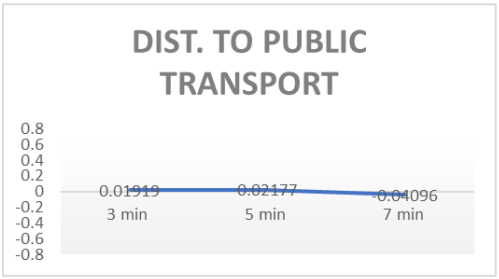


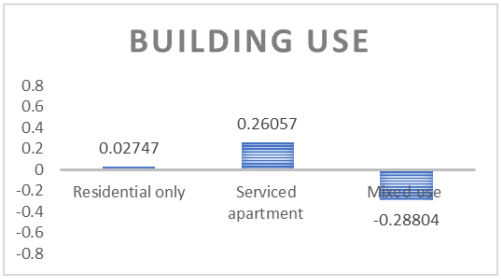


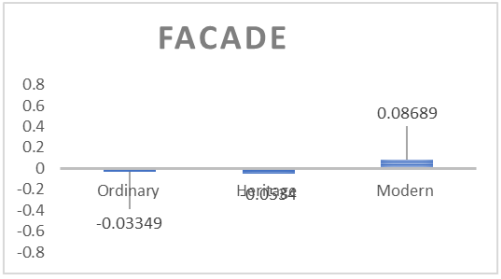


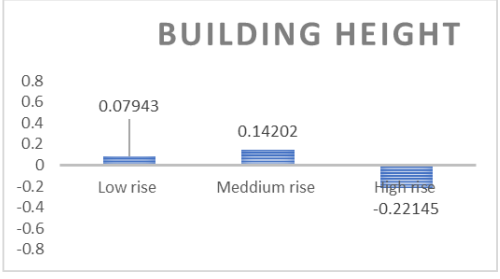






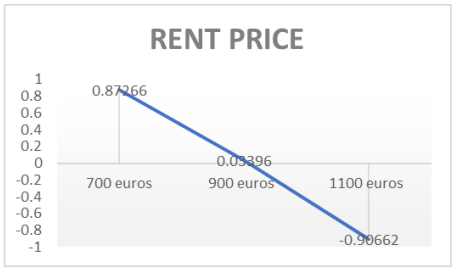


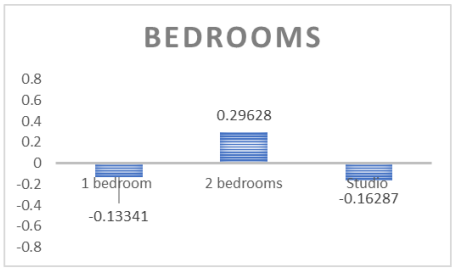


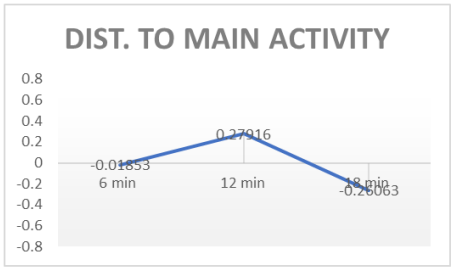


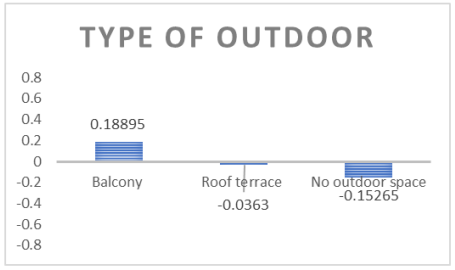
Appendix 14

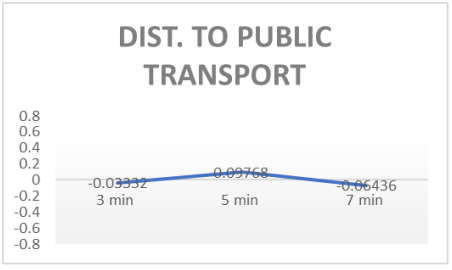
Internationals one-person household. Attribute level preference representation

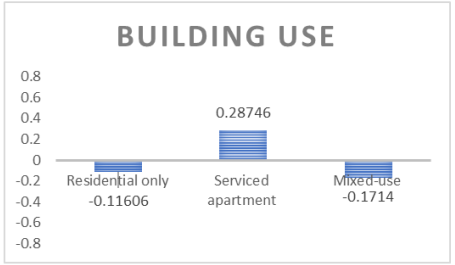


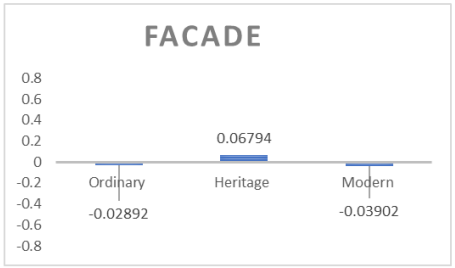


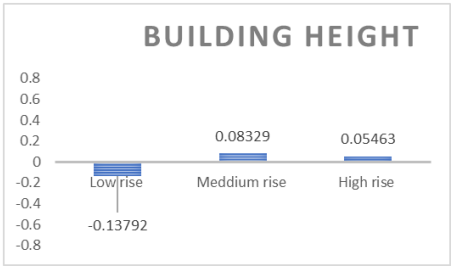




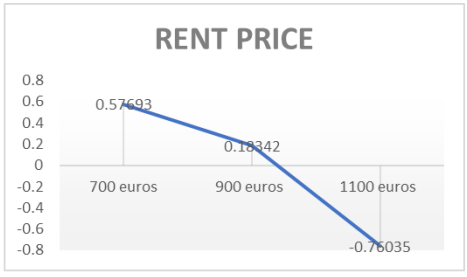


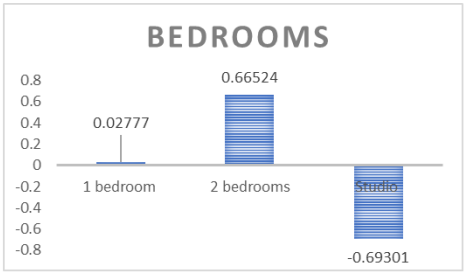


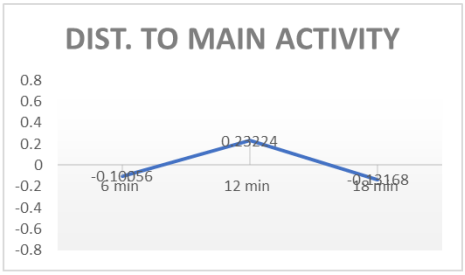


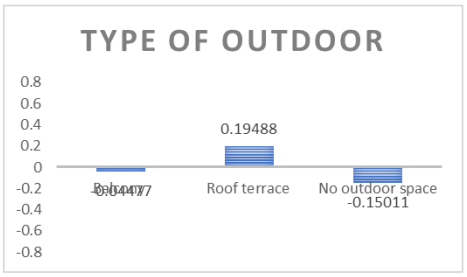


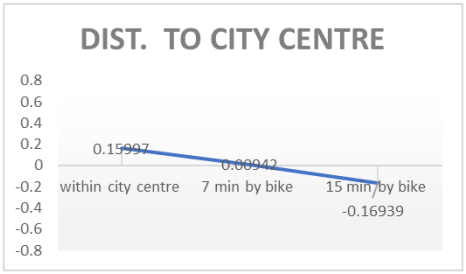
Internationals two-person household. Attribute level preference representation

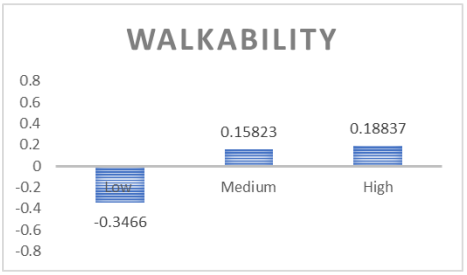


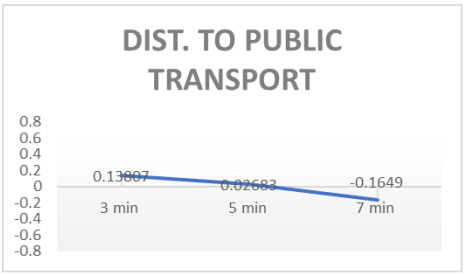


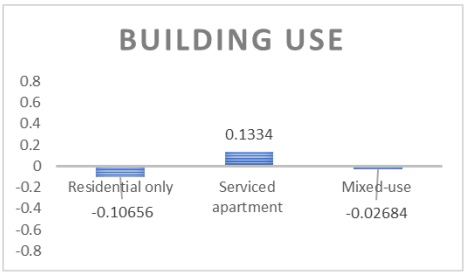


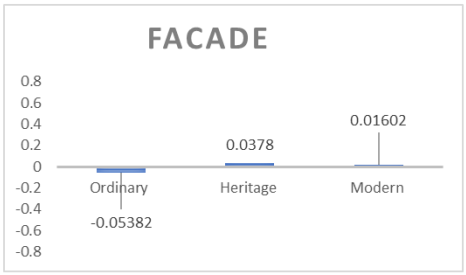




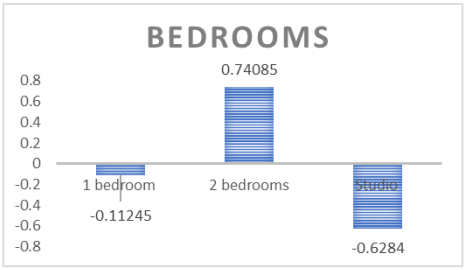


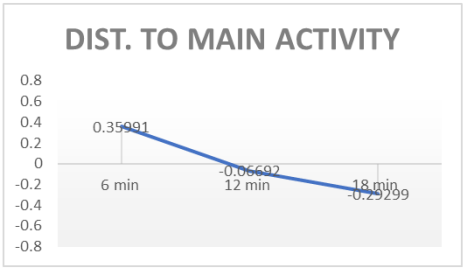


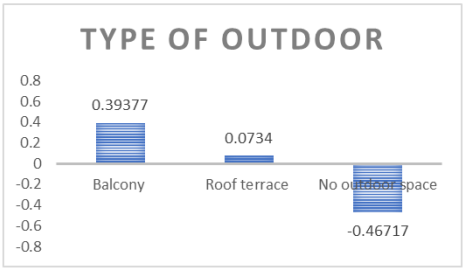


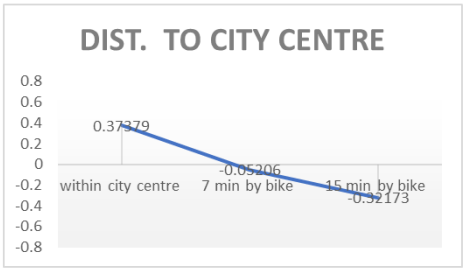


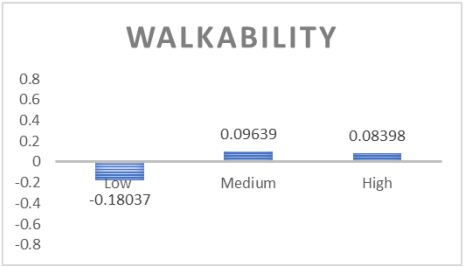
Internationals three person household. Attribute level preference representation

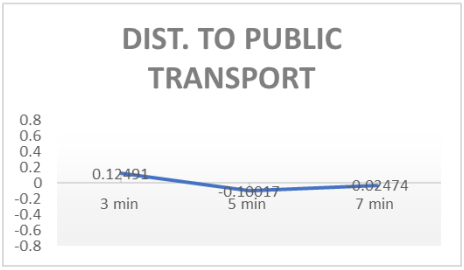


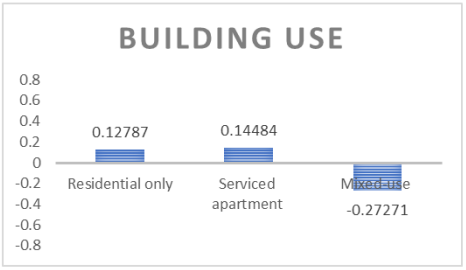


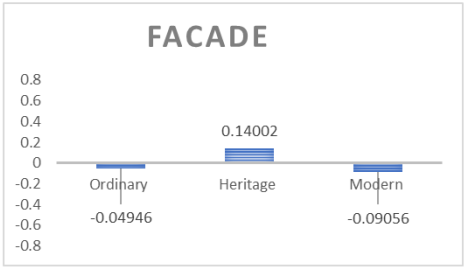


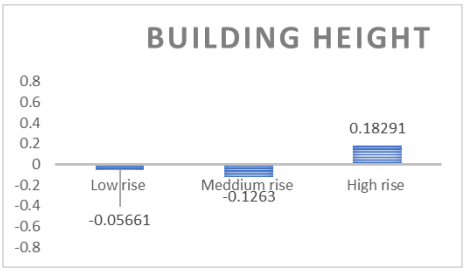






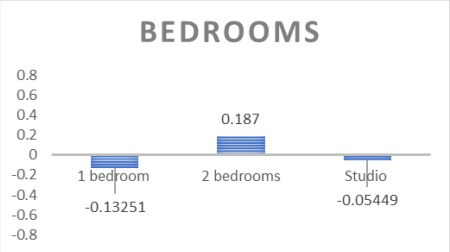


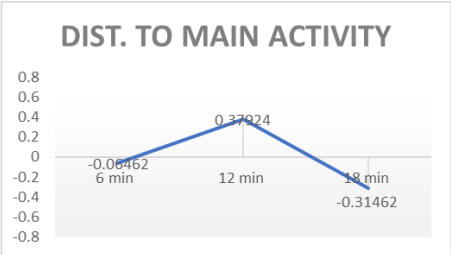


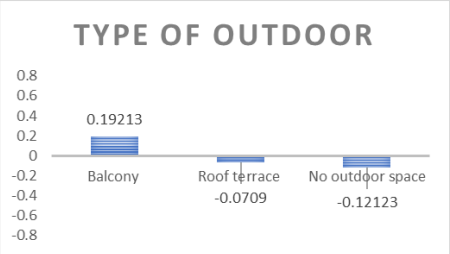


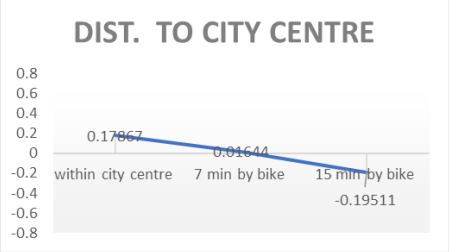
Appendix 15

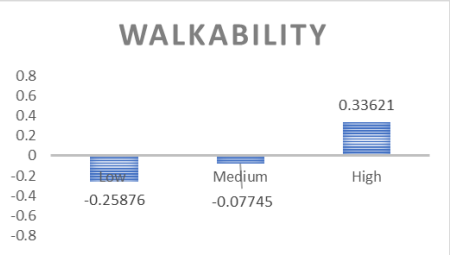
Students one person household. Attribute level preference representation

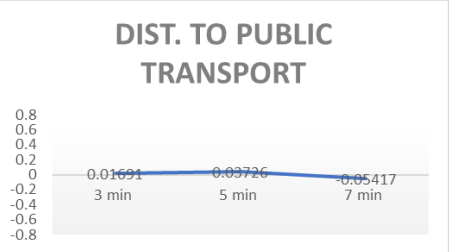


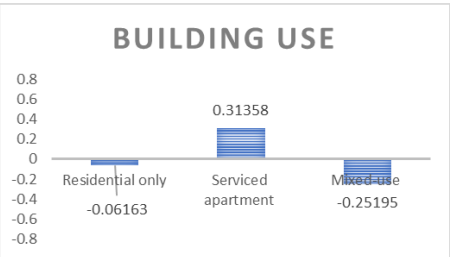


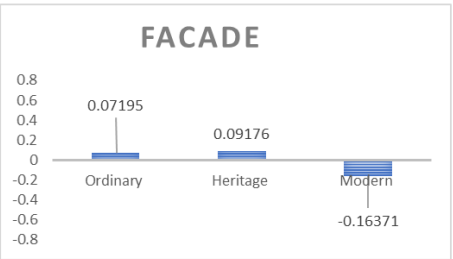


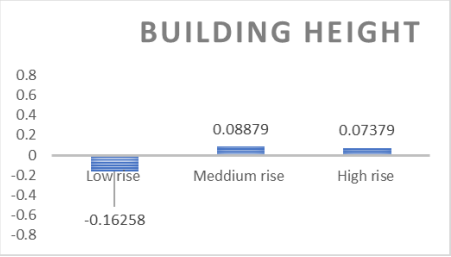




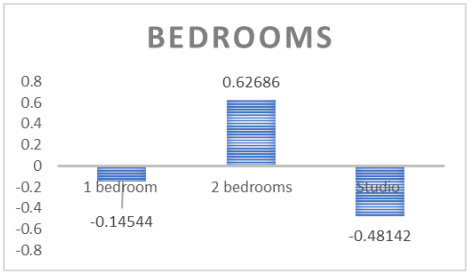


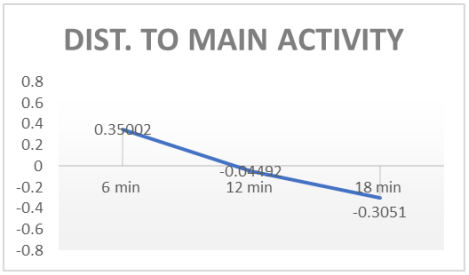


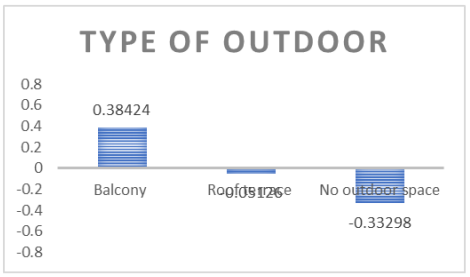


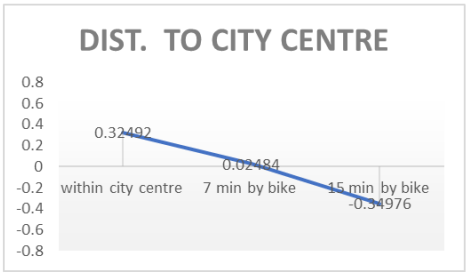


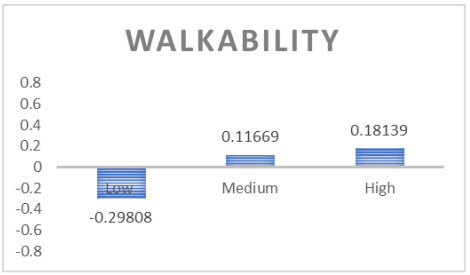
Students three or more person household (Roommates). Attribute level preference representation.

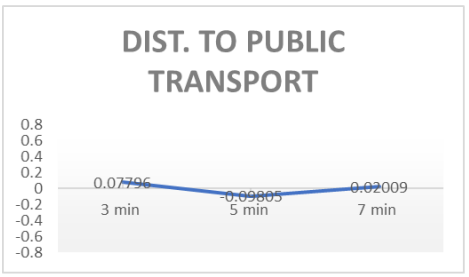


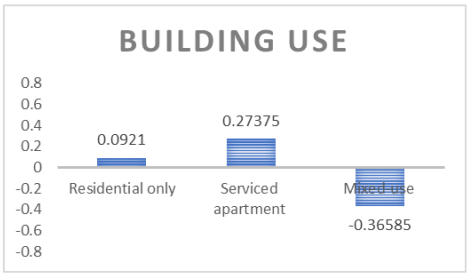


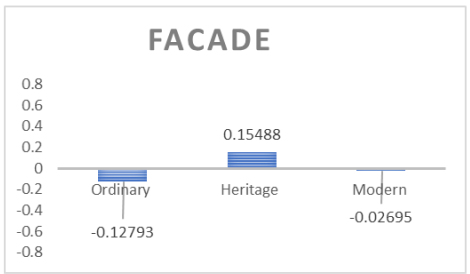


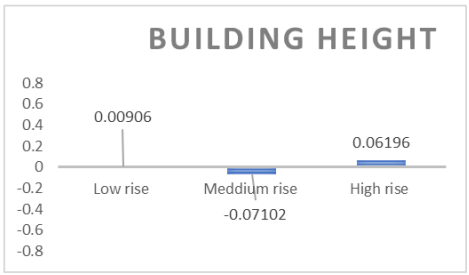












Housing Suitability analysis of vacant office buildings.

Understanding target group preferences using a stated choice experiment

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SUMMARY

According to the CBS (Dutch Central Bureau of Statistics) in the period of 2017-2040 the total number of inhabitants in the Netherlands is forecasted to grow by just over 1 million to a total of 18.1 million people (+6%) and the percentage of household growth is expected to increase around +9.2% being immigration the main contributor to the population growth (CBS, 2017a; CBS, 2017c). At the same time, in the Netherlands, a big amount of office buildings are vacant, The last Office Market report of the NVM (2017) reveals 15.9% of total office stock in the Netherlands space were available for rent or sale at year-end 2016. New buildings are mainly built to replace the old stock. This construction of new real estate leads to oversupply and old buildings become vacant. In order to deal with vacant office buildings, property owners have several possible strategies: renovate or adapt to new market segments (conversion).

Conversion is the process of changing or causing something to change from one form or another. It is a sustainable way of addressing vacancy and it can be use as a mean to facilitate adaptive reuse of buildings and contributing to today's historical cities. Buildings that can be reused do not have negative effect on the environmental impact. They do not have to be demolished and the old building materials do not have to be decomposed, burned down or stored under soil.

Although there are good reasons to convert vacant office buildings into housing, the number of conversions is still scarce. Real estate markets tend to be functionally separated and hence office investors do not invest in housing and vice versa and most of the time the possibilities of conversion are not clear to office owners (Remoy, 2010). Also, big challenges involve conversions, among them are the physical and design aspects, location, financial and legal aspects.

Remoy et al. (2014) developed a method to determine the adaptive capacity of buildings (AC method) and Geraedts and Nicole de Vrijto (2004) developed a project evaluation instrument, called "Transformmeter". This method and instrument complement each other to better

measure the potential for conversion of vacant office buildings into housing. Successful transformation of buildings also depends on several factors and characteristics, physical attributes of buildings and location along with the supply and demand of the market are factors that must be considered, therefore knowing the right target group of people most likely to inhabit a renovated building might minimize the financial risk of conversion.

This research aims to reveal the living preferences of identified target groups of possible tenants, considering their household composition, employment or carrier patterns, and origin revealing environmental and location preferences for living as well as the impact physical building characteristics has on housing choice and finally create a supportive tool that could help municipalities, investors, and real estate professionals to find out how vacant office buildings can be adapted to satisfied future tenant demands and successfully be converted into housing developments.

A questionnaire was made using a stated Choice (SC) experiment that simulated the decision-making process via a survey, in the stated choice experiment attributes were divided in building amenities (flexible attributes) and location and building type (fixed atributes) from where 230 useful responses were obtained to later use and analyze using a Multinomial logit model (MNL) to measure the preferences of the respondents and the level of utility given to different attribute levels. One general model and several socio demographic groups and sub-groups models were generated in Nlogit 5.0.

Main Groups

- Household composition
- Age categories
- Students vs non-students
- Dutch-vs non-Dutch

Subgroups

- Household composition of students
- Household composition of internationals

Subgroups are focus on household composition since is the household composition the one that defines more the needs not only of a single person, but of a group of individuals who are willing to share the housing facilities and look over for the needs of the other members of the family (Buzar, Ogden, & Hall, 2005)

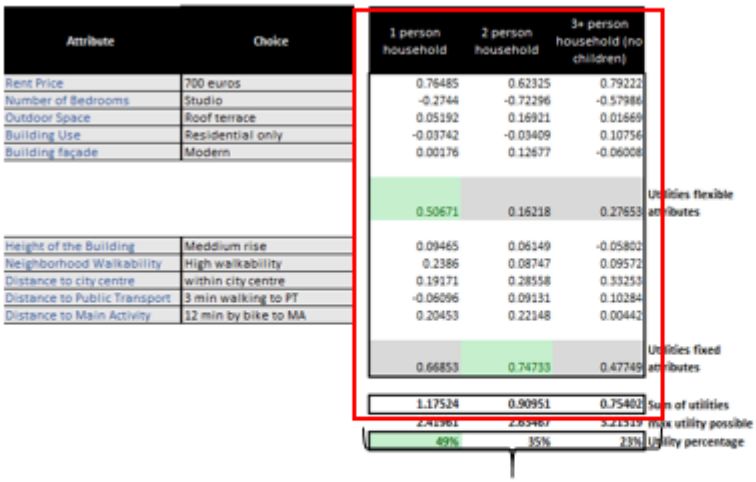
Analyzing the results revealed by the MNL models, it was confirmed that the two main attributes affecting the choice of every target group are rental price and number of bedrooms (flexible attributes). The distance to the main activity place, distance to city centre and walkability level of the neighborhood followed as important housing characteristics (Fixed attributes). Location of a building is something that cannot be changed, hence special attention should be added to its surroundings, like image of the neighborhood and distance to activity centers, such as office districts, universities and commercial zones. The preference for these locations characteristics varies from group to group. For example, for people living with roommates, the closeness to their main activity and city centre is a priority, meanwhile,

couples without children don't think closeness to main activity is a priority when it comes to choosing dwelling. Outdoor space and building use play also an important role when choosing housing for some groups. Being sometimes as important as distance to the place of main activity or distance to city centre. The MNL model also reveals that all groups have a general dislike for mixed-use buildings. But since mixed-use projects revitalized the neighborhoods by bringing more commercial activity trade-off could be made by increasing the walkability level of the neighborhood (by the same building).

Looks of the building play a small role in choice preference for most groups, except for couples and older people in both cases this preference is inclined to modern buildings and heritage buildings respectively.

Based on the results of the MNL models a supportive tool was created to compute the target group preferences or utility given and a case study was made in order to include the validation of the model. Using this supportive tool, This tool can help municipalities, developers, investors, building owners, or other real estate professionals, identify what are the fixed attributes of a building such as location, and physical appearance that different target groups find more attractive and suitable for living and how the flexible attributes can be manipulated to increase the preference level of the target group suggested by the fixed attributes results or to promote other target groups to moving into the converted building.

Groups with bigger preference for the attributes selected are highlighted in green.



Attribute	Choice	1 person household	2 person household	3+ person household (no children)	
Rent Price	700 euros	0.76485	0.62325	0.79222	
Number of Bedrooms	Studio	-0.2744	-0.72296	-0.57986	
Outdoor Space	Roof terrace	0.05192	0.16921	0.01669	
Building Use	Residential only	-0.03742	-0.03409	0.10756	
Building façade	Modern	0.00176	0.12677	-0.06008	
		0.50671	0.16218	0.27653	Utilities flexible attributes
Height of the Building	Meddium rise	0.09465	0.06149	-0.05802	
Neighborhood Walkability	High walkability	0.2386	0.08747	0.09572	
Distance to city centre	within city centre	0.19171	0.28558	0.33253	
Distance to Public Transport	3 min walking to PT	-0.06096	0.09131	0.10284	
Distance to Main Activity	12 min by bike to MA	0.20453	0.22148	0.00442	
		0.66853	0.74733	0.47749	Utilities fixed attributes
		1.17524	0.90951	0.75402	Sum of utilities
		2.41961	2.85487	3.21519	Max utility possible
		49%	35%	23%	Utility percentage

Example: One-person household has a bigger preference for the flexible attributes and two-person household has a bigger preference for the fixed attributes. The sum of all utilities results in a bigger preference for one-person household obtaining 49% of the total utility possible for this group.

Knowing the right target group or groups for a specific project might have the potential to assists developers and real estate professionals in choosing the best structure for reuse, by acknowledging the future user's preferences and reducing investment financial risk by expecting a higher rental rate.

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