MIXED USE

Graduation Lab Urban Area Development
Mastertrack Real Estate & Housing
Msc. in Architecture, Urbanism and Building Sciences
Delft University of Technology, Faculty of Architecture
The composition of multifunctional urban area developments:

Preferences of end-users for inner-city train station areas
MIXED USE

Colofon:

Thesis subject:

The composition of multifunctional urban area developments:

Preferences of end-users for inner-city train station areas

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“Ultimately, it is the mixed-use outcome (a richly textured environment comprising a mixture of life activities) rather than the mixed-use output (a discrete development incorporating a mix of uses) that underpins the success of a mixed-use development project.”

(Cheah, 2010)

“Mixed-use and diversity are desirable in the abstract, but they cannot be identified or measured until one knows how people perceive differences.”

(Hoppenbrouwer & Louw, 2005)
Preface

This document contains the master thesis which is written for the mastertrack Real Estate & Housing. This mastertrack is part of the master Architecture, Urbanism and Building Sciences at the Faculty of Architecture of the Delft University of Technology (TUD).

My interest in spatial development and all of the involved stakeholders combined with my interest in urbanity and the way that cities work have led me to the choice for Urban Area Development as graduation lab. This choice has proved to be a good one. It has led me to an interesting research subject that seems to fit very well within the research context of Urban Area Development. I hope that I have contributed to the existing body of knowledge in the field of Urban Area Development with this research. Besides that, I hope that the results, the conclusions and the recommendations of this research will be used in the practice of spatial development, or that they will form inspiration for further research.

I have experienced the past year in which I have done my research as a very inspiring period. At the start of the research project a year seemed to be a quite long period, but looking back I consider the period as almost too short to realize a decent research project. But I guess that is maybe a part of doing research, once you get started and get inspired it is hard to step back and oversee the bigger picture. However, I think that I managed to realize my research goals quit well within the time given. Therefore I would like to thank my research supervisors, which have allowed me to do my research in a very pleasant and convenient way. They have supported me at various expertise fields. All together it felt like working with a good team, of which the members were very well attuned to each other.

I would like to thank Wout van der Toorn-Vrijthoff as my main supervisor for keeping me sharp at the overall level, for seeing the bigger picture. His comments and feedback where inspiring and mind sharpening, mainly on the fields of Urbanism and Urban Area Development. My second supervisor, Philip Koppels, I learned to know as a real economist. Due to my own background in this field, it was very nice working with Philip due to speaking ‘common language’.

Philip has really helped me with the operational part of my research, in getting from A to B. His comments and suggestions really helped me getting forward. The last member of my ‘graduation team’ that I would like to thank is Clarine van Oel. She has supported me when things got exited seen from a statistical perspective. I think we have encountered and tackled some advanced statistical aspects in this research. The support of Clarine has been crucial in getting the quantitative research results that have been of great value for this master thesis.

At last I would like to thank my graduation company for facilitating my research project. I have experienced a warm welcome within the organization and I have learned to know the organization as an inspiring and ambitious company. This has led to the right circumstances to conduct my graduation research. My special gratitude goes out to Daniel Boot, who has been my supervisor on behalf of the graduation company. He has supported me with both his academic and practical expertise. It was nice to work with a supervisor that has been recently graduated himself. In this way Daniel could provide me a lot of support during my research, in particular regarding the research process. I have learned to know Daniel as a young, eager and positive person with whom it was nice working. His scientific way of thinking combined with insights in the practice of spatial development where of great added value for this research.

Joost Roks
Breda/Delft
March 2011
Management summary

This document contains the findings of the research which has been done for the graduation project of the mastertrack Real Estate & Housing. It reports the main process of the graduation research which has been performed in the last year. The focus of this research is on urban area developments. More in particular on the composition of the real estate programs which can be developed in urban area developments. The aim of the research is to derive the preferences of end-users for several real estate programs. This in order to be able to create an optimal division between the possible area functions within a certain area. This research is seen from the perspective of parties who are active in spatial development. Therefore, end-users have been defined as parties or persons who buy, rent or use the area or buildings which are developed in area developments. An overview of the defined end-user typologies can be seen in the following figure:

<table>
<thead>
<tr>
<th>End-user</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident</td>
<td>A resident that seeks an optimal place and environment to live.</td>
</tr>
<tr>
<td>Organization</td>
<td>An employer that seeks an optimal accommodation and environment for his organization. Employees are also classified under organization, assuming that an employer will take into account the preferences of his employees.</td>
</tr>
<tr>
<td>Visitor</td>
<td>A visitor that is attracted to the area due to other aspects than living or working.</td>
</tr>
<tr>
<td>Investor</td>
<td>Although an investor can not be seen as a literal end-user (however, this could be in the case of the owner-user) his preference is just as important as the literal end-users because the investor can sometimes also be a very important purchaser of development projects. An investor seeks an optimal financial efficiency of his investments.</td>
</tr>
</tbody>
</table>

Based on the contemporary value, the accessibility and the possibilities for the presence of multiple area functions a choice has been made for inner-city train stations as central area typology within the research. Based on this area typology the following possible area functions have been defined:

- **Urban Living**: Defined as the space that is needed for living.
- **Office**: Refers to the space that is used to facilitate office activities.
- **Retail**: Refers to the space that is used to facilitate retail or commercial activities. (shops, department stores, etc.)
- **Leisure/entertainment**: Commercial exploitation of spare time activities. (restaurants, hotels, bars and pubs, etc.)
- **Social amenities**: Includes non-profit, care and educational organizations (hospitals, schools, etc.)

In order to analyze the preferences of end-users in a solid way, a quantitative research approach has proved to be most appropriate. Therefore an online questionnaire has been used to derive the preferences of end-users for the several possible area functions. In this questionnaire a case study (Stationskwartier Breda) is used which represents an inner-city train station location. First, this case study is described to the respondents of the questionnaire. Thereafter, the respondents are asked which functions they prefer on this location typology. This is done by means of two methods. The first method which is called the ‘discrete choice’ method. This method makes visualizations of different possible real estate programs. These visualizations are divided over sets of two options in a strategic way. Respondents are forced to make a choice between these two options. Based on these choices, the preference patterns of the respondents can be derived. The other method is called the ‘direct method’. This method makes use of scrollbars with which the respondents can indicate the amount of desired presence (%) per area function. Beside the preferences for the different area functions, which is the main aspect of the research, key figures regarding the feasibility or ‘added value’ are also taken into account. The results of these analysis are described in the following.

First we will look at the construction of the research population. Respondents have been asked how they see themselves in relation to the area typology. This has resulted in the following construction of the research population:

The figure shows a first glance of the potential of the area typology of inner-city train station locations. Considering the discrete choice method the following conclusions can be made. The advantage of the discrete choice option is that besides the preferences...
for the total area composition also the preferences for the individual area functions can be analyzed. In this way it can be seen which level (high, medium or no presence) is preferred for each individual area function. This will be discussed in the following. First, the utility of each function will be discussed. The utility states the importance that respondents grant to a specific function in relation to the choice that they make for a specific area composition. In other words, the utility states the role that a function has played in the choice behavior of the respondents. This role can be positive or negative. Therefore, a high utility of a function doesn’t per definition reflect a high preference for that function. It only shows that the function has played an important role within the choice for a certain visualization, which can be caused by both positive or negative preferences. The utility value of each area function can be seen in the following figure:

In general, retail and leisure are most preferred amongst the total research population. The residential function seems to be desired at an medium presence level, where the office and amenities function seems to be least preferred with a highest probability of choice for the no presence level. When we compare the ranking of the preference for the several area compositions in appendix 6 with the ranking of the financial feasibility of the several area compositions in appendix 8, connections between preference and feasibility can be found in most cases. This indicates that there should also be enough potential seen from the feasibility perspective to realize the most desired area compositions. The results of the direct method can be seen in the following figure:

When looking at this figure, it can be seen that all the area functions are desired at all times. As well for the total population, as for each specific end-user typology. The figure shows that there are no very large differences. There are no extreme low values. This shows that all area functions have played a significant role within the choice behavior of the respondents. Based on the analyses of the individual function levels in the discrete choice method in chapter it is possible to derive conclusions regarding the general preference patterns for the mutual presence levels of the different area functions in inner-city IC train station locations, which can be seen in the following figure:

In the above figure, the area functions are ranked based on their utility from left to right. On the basis of the ranking it can be seen that the function of amenities has the highest utility where the residential function has the lowest utility. Based on this, it can be said that the variation in presence level of amenities matters a lot in the choices of respondents where the variation in presence level of the residential function matters less. Beside the function of amenities, there are no big differences between the values of the area functions. There a no extreme low values. This indicates the mixed-use potential of the location typology. In other words each function is desired at a certain level. This proves that there is enough potential for mixed-use to make it interesting for market parties consider the development of mixed-use real estate program.
research methods. Retail is systematically preferred at a higher level and offices are systematically preferred at a lower level within the discrete choice method compared to the direct method. It is expected that this is caused by the difference between the predefined visualization (and the appreciation of this visualization) within the discrete choice method and the own imagination of the respondent within the direct method. Both methods have their advantages and disadvantages. In the direct method the advantage is that the exact amount of desired presence can be determined since there are no pre-defined levels. Another advantage is that the imagination of respondents gets more freedom. However, the latter can also be a disadvantage because it can be questioned if every respondent has the capability to imagine the effects of the compositions that will be created. These effects will be more understandable within the discrete choice option. This due to the visualization which is used within this method. However, this visualization has also a disadvantage, value judgements regarding the appearance of the functions can be made which can influence the research results. Another advantage of discrete choice method is that it gives a more abstract preference pattern, which makes it possible to see what happens to the preference when a function has a higher or lower presence level. The above differences in advantages and disadvantages show that there is no one ‘truth’. Because of this, the methods used have been compared and analyzed in order to come to solid conclusions.

The research results are based on end-user preferences regarding mixed use in station areas in the Netherlands in general. The conclusions aim to give insights in trends based on the preferences of end-users. The actual situation can differ from these trends per location under the influence of o.a. the difference in pressure on the local property markets and different location characteristics. The generic results of this research could be translated to concrete cases in practice by matching the preferences patterns of this research with the current supply on a specific location and its surroundings. In this way, it can be determined which (mix of) functions should be developed at a certain location. For instance, this research shows that there is a high demand for retail on the specific location typology. This could be a reason to plead for the development of retail. However, if the direct surroundings of the location already contain much retail of good quality, the demand for retail will become more relative. In this way, the generic research results should be translated to (the context of) a specific urban area development when they are used in practice. This research has a spatial-economic orientation and has focused on the influence of the composition of a real estate program on the acceptation or experience of an area development by end users. This instead of a focus on the influence of end-user characteristics on the acceptation or experience of an area development. The latter is also of influence on the acceptation or experience of the composition of an area development but belongs more to social science related research which is not our main research field. Besides that, the intellect that determines choice behavior of a human beings is very complicated, even for advanced researchers. Therefore, the results of our research will be relative because social and psychological effects will also have influence on the choice behaviour of respondents. In this way, it could be said that every end user is unique. The same is true for a location. The uniqueness of every location and end-user should be kept in mind when interpreting the results of the research. However, the main goal is to search and explore trends or average preferences in the choice behavior of end users. In this way there is aimed at getting insight at global preference patterns in the initiative phase of an area development. This in order to be able to develop areas with compositions that are based on market demand so that they will be occupied quickly.

The results of this research should be interpreted as preference patterns which could be used for the definition of a global real estate program on a inner-city IC train station locations. The research gives an indication of the desired presence level of several area functions based on the location typology of inner-city IC train station locations. This can be used to create an optimal real estate program for the specific location. The question how the functions should be divided over the area is another research subject and is therefore not taken into account. Research has been done towards to favorite placement of functions on the different sub-area within the case-study. However, the question whether functions should also be mixed within these sub-areas (and maybe even in buildings) and how the mix should be arranged is not taken into account. The latter aspects are more related to urban design, in this way the results of this research could be used as input for o.a. the urban designers of an area development.
Main concepts

The concepts that will be central in the research will be explained in further detail in the following.

Mixed use:
In this research the concept of mixed use is defined by the presence of several physical functions within a determined place. It relates to the amount of different physical functions within one determined place and the mutual composition of these functions (amount of presence of the different functions). A more detailed description regarding the definition of physical functions and the determined place can be found in the theoretical framework of chapter two. Within the research the concept of mixed use is used as synonym for function mix.

End-users:
The people that are going to use an area with its build structures. Within this research the concept of end-user is seen from the perspective of parties that are active in the spatial development of urban area developments. A subdivision is made towards typology. This results in the following division: residents, organizations, visitors and investors. A more detailed description of the concept of end-users can be found in chapter 2.

Market demands:
The preferences of end-users. In the research related to the functional composition of an area. This comes down to the preferences of end-users for the presence levels of different area functions on a certain location, which will lead to an optimal functional composition (real estate program).

IC train station:
Intercity train station. A train station that forms a main transport hub within the railway network of The Netherlands.

Area Function:
A specific use (combination of activities and/or processes) which can be accommodated in a building on a specific location. In this research five area functions are distinguished: residential, office, retail, leisure and amenities. These area functions are described in more detail in chapter two.

Location typology:
This concept refers to the type of location. In this concept the general characteristics of a location regarding to o.a. the urban situation and density are taken into account.

Functional composition:
The ensemble of different area functions in a certain area. This relates to the mutual presence proportions of the different area functions. The amount of presence (expressed in a percentage or level) is central in this research. There is searched for an optimal division of functions over the location typology, which results in an optimal functional composition (real estate program).

Stated Preference:
Survey-based research method by which it is possible to find ‘value’ or ‘preferences’ as derived from people’s responses to questions.
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CHAPTER 1

INTRODUCTION

FUNCTIONAL

RESEARCH MIXED

COMPOSITION

YIELDS THEREFORE DISCUSSED

THEORIES DONE HYPOTHETICAL

METHODS POSSIBLE

KNOW BENEFITS

DEVELOPMENTS REAL

QUESTIONS ACEPTATION

BESIDES STATED AREAS

APPLICATION OF METHODOLOGY

PREVIOUSLY HISTORICAL DATA

BOKA MEASURES OF DATA

STUDY QUESTIONNAIRE

PREVIOUS FINANCIAL MEASURE

APPROPRIATE DEVELOPED

CHOICE

IRONMENT

LITERATURE

MADE LEVEL END-USER EXPERT

NEEDS [FOOTNOTE FREQUENCY]

BENCHMARKING PRINCIPLES

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PREFERENCES SURVEY QUESTION

PREFERENCES COMPOSITIONS

END-USER BASED

DEVELOPERS DEVELOPED

DEVELOPERS DEVELOPED

DEVELOPERS DEVELOPED

DEVELOPERS DEVELOPED

DEVELOPERS DEVELOPED
Introduction

In this chapter an introduction to the research subject is made. First, the research relevance will be discussed after which the research context and focus will be described. After that, the research questions will be stated in relation to methodological approaches to answer them. In the following, the research objective and the desired end product will be discussed. Finally, the research design will be shown.

1.1 Research relevance

1.1.1 Research motive

Mixed use is a contemporary term in urban area developments. According to Louw and Bruinsma (2006) there has been a paradigm shift in town planning during the last decades, away from promoting the segregation of land uses toward promoting their integration. The mixed-use development has become an important planning paradigm in various European and North American cities. According to Grant (2002: 71) mixed use developments “have become a mantra in contemporary planning, its benefits taken for granted”. There are several reasons why the term mixed use is used and applied frequently in recent and new projects. Grant (2002) links the term mixed use developments “have become a mantra in contemporary planning, its benefits taken for granted”. There are several reasons why the term mixed use is used and applied frequently in recent and new projects.

1.1.2 Personal motivation

I always had an interest for urbanity and the way that cities work, in particular for the interconnection and cohesion between different functions. What appeals to me is the combination of different functions and the effects that can occur due to that. Combining this with my interests for finance and marketing have made me curious about the appreciation of mixed use by end users of urban area developments. The process that leads to an actual composition and division of functions in an area development fascinates me. I wonder how these compositions and divisions are determined and if they suit the preferences of the end-users. My main interest is therefore how mixed use compositions of an urban area development are determined and if this is in line with the preferences end-users.

1.1.3 Scientific & Social relevance

Not much research regarding the preferences of end-users for the mix of functions in urban area developments has been done. That is the reason why there is not much knowledge available about this particular subject. Therefore the results of this research could possibly add to the existing body of knowledge regarding to this research field. This research could therefore offer scientific relevance by gaining insight in the market demands regarding mixed use. There will be aimed at developing knowledge about global preference patterns for mixed use compositions on inner-city train station areas in the Netherlands. Furthermore, this research could also be of great social relevance because there is not much insight in practical experiences with function mix. If this insight grows, the change that the functional composition of area developments matches the preferences of end-users becomes larger, which is beneficial for both the end-users and parties which are active in spatial development.

1.1.4 Practical relevance

There are a lot of inner-city train station locations in The Netherlands that are (going to be) (re-)developed, right now or in the coming years. The research subject is therefore very contemporary and relevant for many parties who are active in spatial development. The ‘Nieuwe Sleutel Projecten’ (NSP) are good examples to illustrate the contemporary value of the research topic. The NSP contain six of the largest urban area developments around inner-city train stations in the Netherlands. Beside these six projects there are also numerous other similar (smaller) projects that are (going to be) developed in the Netherlands.
All parties who are active in spatial development can use the results of this research to gain insight in the preferences of the potential end users of inner-city train station areas. This could be useful in order to attune the developments to the preferences of the targeted end-users and to show to third parties that there will be support for a certain development or plan.

1.1.5 | Relation with the research program
Within the mastertrack of Real Estate & Housing there has been chosen for the graduation lab of Real Estate Management, more specific the Urban Area Development lab. Integral urban area development deals with the demand and supply of diverging functions. This is the link with the selected research topic which investigates the composition of an area regarding to different Real Estate uses (mixed use). The research aims to indentify the demand regarding the composition of diverging functions in an area. This in order to make it possible to attune the supply (of diverging functions) to the demand. In this way the research topic is connected to the focus of the Urban Area Development lab which is on integral urban area development.

1.1.6 | Learning goals
Within my graduation research I would like to gain insight in the preferences of end-users regarding mixed use area developments. Therefore I would like to get familiar with (and be able to apply) preference research techniques in order to be able to measure the preferences of end-users. A quantitative research approach will be most suitable to use in my research. Regarding to my statistical knowledge, it will become a challenge to reach the level that is needed for this kind of research. My goal is therefore to fill in the current gap regarding statistical knowledge and skills within the given time. The development of a web-based questionnaire and the design of renders which will be used in a choice experiment will also be a challenge.

To recap: the main challenges and learning goals of the research will be found in 3-d modeling (designing), statistical analysis and the online questionnaire development. Besides that I would like to gain experience in conducting a sound literature survey in order to explore the research topic and gain more in depth knowledge about the subject. The writing of a good and structured thesis is also one of my goals within this research.

1.2 | Research Context & Research Focus

1.2.1 | Focus on End-user
The wishes of end-users form an important role within the power forces of urban area developments. In interviews with persons within several expertise fields of the urban area development practice, there has been tried to sum up the most important power forces within urban area developments in relation to the determination of functions within an area. These power forces can be seen in figure 1. In relation to the aspects mentioned in figure 1, market demands and financial interests are the most important aspects, seen from the perspective of parties who are active in the spatial development practice. These are the only aspects on which market parties can have influence, the other power forces can been seen as external influences. So the external power forces will be relevant but hard to influence. Therefore they will not be the focus of this research. End-users are the people that are going to use the area with its build structures. They determine how an urban area development will function or ‘work’. Therefore they will determine, to a great extent, the success of an urban area development. Hence, in theory it can be said that area developments are being developed for their end-users. In this way, area developments are all about people and their preferences.

<table>
<thead>
<tr>
<th>Power force:</th>
<th>Definition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Ambitions</td>
<td>Accomplishing goals on the political agenda related to spatial development.</td>
</tr>
<tr>
<td>Economical Situation</td>
<td>The situation within the economical cycle. (employment rate, interest rate, inflation, demand/supply relation)</td>
</tr>
<tr>
<td>Location potential</td>
<td>The potential of the specific location typology (o.a. the accessibility of the location and its hinterland and the geographical location)</td>
</tr>
<tr>
<td>Financial interests</td>
<td>The possibility to develop a financial feasible plan. (land revenues, land ownership, the possibilities for (commercial) exploitation and the yield on investments)</td>
</tr>
<tr>
<td>Legal requirements</td>
<td>Standards, laws and conditions which are obliged and therefore have to be met.</td>
</tr>
<tr>
<td>Market demands</td>
<td>The preferences of the end-users which will be going to use the area with its build structures</td>
</tr>
</tbody>
</table>

► Figure 1: Power forces in Urban Area Developments
Based on this starting-point, the focus of this research is on the preferences of end-users. On the other side, preferences will have to be realistic and feasible. That is why financial interests are also taken into account in this research.

1.2.2 | Research context

It would seem logical that the preferences of end-users, as discussed in the previous, would be central in urban area developments. This in order to lead to the development of an area which will be used to its full potential. However, this is not always the case in practice. This can be caused by two aspects. The first aspect is that there is too much focus on other power forces that play a role within urban area developments, instead of the preferences of end-users. The second aspect is that the preferences of end-users are not known or based on wrong estimations.

The first aspect will be illustrated with two examples. First, an example of a focus on financial interests. This example is on building level instead of area level, however it gives a good illustration of the other aspects that play a role besides end-user preferences. For several years now, the lease contracts (in particular in commercial real estate developments) have played a leading role in the development of buildings. If a building is leased for a long period to reliable tenants, the sale (to an investor) is almost guaranteed. Therefore the focus is sometimes more on the investment value (the guarantee of future cash flows) than on the quality of the actual building itself. This resulted in buildings that were abandoned after (or sometimes even before) the expiration of the first lease contract because the preferences of the actual end-users where not taken into account (enough). Regarding to this, it is therefore important for real estate developers to determine which of the two parties will be their actual client: an investor or the employees who will actually work in the office. The latter party seems a more sustainable option when looking at the long term.

The second example is one that relates to a focus on political ambitions. In the North-East of the Netherlands, in the province ‘Groningen’ plans for a large spatial development called ‘De Blauwe Stad’ were made. The plan arised from the political ambitions to solve the current problems in this area. The plan was supposed to attract rich people from the west of the Netherlands to the region. By means of creating the right conditions (amongst others: a large lake for leisure activities) the targeted people should automatically come to the area. At least, that is what the people thought who were responsible for the plans. Later on, this proved to be a good example of ‘wishful thinking’. The desired target group did not come to the area. Most probably because the ‘right conditions’ were not known and secondly the willingness to move to another location for these ‘right conditions’ was also not known. Therefore, political ambitions should be attuned to realistic plans, they should be based on real preferences in order to prevent wishful thinking. As has been illustrated in the previous, too much focus on one of the power forces within urban area developments could lead to failing urban area developments. However, a focus on end-users could be combined with all the power forces in urban area development. Moreover, if a ‘market approach’ is used as starting-point in an area development, the end-user should be the central power force. It should be the leading aspect on which all the other aspects should be attuned. This brings us back to the main aspects in the real estate market: those of supply and demand. The demand should be leading and the supply should be attuned to it in order to create a healthy market situation. When focusing on this principle the end-user is very important. It is even more important to know the preferences of the end-user.

This leads to the following cause of insufficient attention for ‘market demands’. The second cause is the process of how preferences of end-users are determined. Often it is not very clear how real estate developing parties decide which functions will be developed on a certain location. Sometimes developers think that they can take these decisions on the base of their experience. In other cases they decide to do market research or consult a real estate broker who is supposed to have market knowledge in the particular area. However the latter two options are often based on historical data (comparable projects or transactions in the past) but in a time of great uncertainty and rapid changes, state of the art information regarding the preferences of end-users is important. A central aspect in this research is therefore the development of a method to obtain state of the art information about end-user preferences. In this research the focus will be in particular on the preference of end-users regarding the desired (mix of) functions in inner-city station area developments.

1.2.3 | Departure points

As described in the above this research is based on the starting-point that a focus on the preferences of end-users will be the most sustainable option in spatial developments. With regard to end-users, target groups are often used in spatial development practice. This research is focused on a ‘location based’ development process. That is: the starting point is the location on which a plan will be developed. In that case, parties believe that they have the knowledge and experience to determine which functions are desired on a certain location. Based on that they select their target groups on which they attune their development. A choice for the wrong functions (which will lead to the wrong target group) could therefore be catastrophic. In this research approach there will be tried to find a solid method for determining which functions should be developed at a certain location in order to use its full potential. In theory it would be desirable to ask every possible end-user which functions he or she would like to have developed at a certain location. In this way state of the art insight in the area potential could be
Based on the assumption that the preferences of end-users will differ per location typology, a choice has been made for a focus on a specific area typology. In relevant literature, mixed use is often linked to urbanity. Inner-city locations with a good accessibility have the most potential for mixed use (Lau, 2003). This, combined with the contemporary value, has led to the choice for inner-city train station areas as location typology.

To illustrate the contemporary value of inner-city train station areas we will use the example of the ‘Nieuwe Sleutelprojecten’ (NSP), which will be described in the following.

The NSP contain six of the largest urban area developments around inner-city train stations in the Netherlands. These urban area developments are all situated around train stations which are connected to high speed train connections (HSL). The integral urban area developments contain plans in which not only the train station, but also the surrounding area is (re)developed in order to give the city an economical boost (VROM, 2006). When looking at the function mix of these plans, which can be seen in figure 2, various compositions can be perceived. In relation to the differences in the composition, it could be questioned if there is a ‘right’ or ‘most suitable’ composition for this kind of area typology. This is exactly what will be investigated within this research.

1.2.4 | Inner-city train station locations
The focus on area developments creates a scale level that enables multiple functions in one area. The goal of the research is to gain insight in the preference of end-users for these multiple functions and their mutual composition. This brings us to the concept of mixed use (which will be further defined in chapter 2). This concept is encouraged in several policies and theories, but there is not much experience regarding to the concept in practice. This is partly caused by the lack of knowledge about the preferences of end-users regarding to mixed use developments.

For a successful implementation of mixed use, state of the art information is needed about the preferences of end-users. The preferences of end-users regarding to mixed use that will be investigated in this research, will be narrowed down to a specific location typology. Regarding to the concept of location it can be said that how higher the scale level, how higher the chance that mixed use will occur. Considering the size of average urban area developments, this scale level should per definition give possibilities for mixed use. The concept of mixed use is therefore seen from the perspective of area level. It relates to multiple functions that can occur within a certain area.

Based on the assumption that the preferences of end-users will differ per location typology, a choice has been made for a focus on a specific area typology. In relevant literature, mixed use is often linked to urbanity. Inner-city locations with a good accessibility have the most potential for mixed use (Lau, 2003). This, combined with the contemporary value, has led to the choice for inner-city train station areas as location typology.

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Regarding the inner-city train station locations, that are central in this research, a demarcation has been made towards intercity (IC) train stations. The focus will therefore be on a national level. This differs from the examples of the NSP, in which the focus is also on international level due to the direct connection to an international railway network.

To summarize, the focus regarding location typology will be on inner-city IC train station locations in the Netherlands. There is aimed at gaining insight in generic preference patterns of end-users for the function mix of this area typology.
1.3 | Research Questions

1.3.1 | Problem statement
In the current real estate market situation the end-user has more and more influence on real estate developments. The days that almost any project could be sold due to the shortage of supply on the real estate market are over. End-users have more choice due to the current oversupply on most segments of the real estate market. Therefore they are in the position to choose and state demands. Because of this situation, it is important for market parties who develop real estate to take the preferences of end-users into account and to distinguish themselves. If a project is developed nowadays it needs to be instant hit, otherwise the risk of vacancy occurs due to the current oversupply on most market segments. This allows people to choose amongst other projects if a certain project does not fulfill their exact needs. End-user preferences are therefore an important key in the success of urban area developments.

In the market situation described in the above the parties active in spatial development are very dependent on the end-users of real estate. To guarantee the continuity of their organizations (who are part of a sector which is dependent on market functionality) it is important to develop market conform products or services. This aspect is the departure point of the research, in this way the ‘market approach’ is a central theme in this research, in other words: the end-user decides.

Narrowed down to the research subject, this comes down to finding a way to determine how inner-city train station areas could be developed with functional compositions that are ‘market conform’. This comes down to the development of train station areas that fulfill the preferences of end-users regarding the functional composition of the train station area in the best way. This can only be done if there is insight in the preferences of end-users regarding the functional composition of the area.

The parties who realize the theories and policies concerning mixed use often rely on financial motives, therefore they have interest in knowing what the market potential of certain functional compositions is because they desire (financial) guarantees and dodge risks. Therefore it is interesting to research if the growing demand for mixed use in theories and policies is also desired by end-users in practice. The main problem/question of the research topic is therefore:

Is there enough potential for mixed-use on inner-city train station locations in the Netherlands to make it interesting for market parties to develop the current theories and policies regarding mixed-use?

1.3.2 | Research questions
The problem statement of the above is translated into a study question. The study question that will be central in this research is stated below.

How can state of the art insights be obtained in preference patterns of end-users regarding the function mix of inner-city IC train station locations in The Netherlands?

The study question in the above covers the main aspects in this research. There is aimed at developing a research method which enables ex-ante analysis of the generic preference patterns of end-users regarding the functional composition of train station areas. In order to be able to answer this study question in a solid way, a division into several research questions has been made. The research questions which will be stated in the following, will cover several aspects of the research. Per research question will be discussed which methodology is used to answer the research question.

What are the current theories regarding mixed use?
This question will be answered by means of a literature survey. In this survey research will be done considering a solid definition of mixed use, theories on the main advantages and disadvantages of mixed use and the definition of an appropriate scale level in order to select possible case studies. Some aspects of the literature study will be discussed in more detail in chapter two. The entire explorative literature survey can be found in appendix 1.

How can the preferences of end-users regarding the functional composition of a station area be measured?
This question will be answered by means of an in-depth literature survey. In this survey several methods will be compared, after which a choice will be made for the most appropriate method to measure the preference of end-users. Some aspects of the literature study will be discussed in more detail in chapter two and three. The entire explorative literature survey can be found in appendix 2.

Which functional composition will have the highest appreciation from the end-users of a multifunctional station area development?

The goal of this research question is to gain insight in the most preferred compositions on inner-city train station areas. This insight will be gained by means of the selected research method (which will be further explained in chapter three). Several variants regarding to mixed-use will be tested within a hypothetical situation. This hypothetical situation is based on a case study. On this case study several functional compositions will be projected and respondents are asked to give their opinion about these compositions in a questionnaire. In this way the preferences of end-users regarding the functional composition of station areas can be derived.

Is there a connection between the type of end-user and the appreciation of the functions within the area?
When there will be worked with target groups, it is interesting to know whether preferences differ per type of end-user or not. And if there are any
differences, it is important to know what they are and which aspects are important per type of end-user. The connection between preferences and the type of end-user will be made by means of a classification which will be discussed in paragraph 2.2.

*Will the functional composition with the highest preference also be the most interesting one seen from a financial perspective?*

The previous questions are mainly about the appreciation of certain functional compositions by end-users. It is interesting to know this appreciation by end-users, but this is not the only aspect that determines which functional composition will actually be developed on a location. The financial aspect will also be of great importance. Therefore key figures regarding the added value potency will be attached to the functional compositions. This makes it possible to make more broader conclusions based on both market potential and (financial) added value of the functional compositions.

**1.4 | Objective & intended end product**

**1.4.1 | Objective**

The concept of mixed use has recently grown in popularity and gets more proponents. Grant (2002: 80) states the following about these proponents: “Its proponents cite it as a means to social integration, economic strength and environmental improvement”. If these arguments of proponents are adopted by policy makers and spatial planners, than mixed used can be a concept which can be aimed for as a goal in spatial planning. However, it is not certain if the concept of mixed use is supported by the end-users of real estate developments. But for the actual development of mixed use plans there has to be insight in the support of end-users for mixed use developments. Otherwise there will be no certainty about the potential of mixed use plans. This uncertainty could have the consequence that mixed use projects will not be developed by real estate developers due to the high risk that is caused by the unknown potential of mixed use. Grant(2002) goes even further with the following statement: “As long as experience shows that mixing uses slows market absorption, builders and developers will avoid it.” Therefore this research focuses at a market approach regarding the determination of the potential of mixed use. The research aims to seek if the trend of growing popularity for the concept of mixed use is also reflected in the preferences of end-users and therefore in greater market potential for parties who are active in spatial development.

**1.4.2 | Intended end product**

The results of the actual research should help parties who are active in urban area developments to determine which functions should be developed on a certain location. This research aims at gaining insight in the generic preference patterns of various types of end-users for certain functional area compositions on inner-city train station developments. There is aimed at researching both the preferences of the total research population (all types of end-users) and the preferences per type of end-user. The last aspect will be useful when target groups are used. The goal is to see which target groups differ in their preferences and on which specific aspects. Based on the latter, decisions can be made in relation to which target groups would be interesting to combine in an area and which not.

The research aims at analyzing the demand for both individual functions and for the mutual composition of functions within the area. The fist aspect relates to whether a function should be present or not. This will enable a ranking in the popularity of area functions based the location typology. The second aspect relates to the mutual presence levels of the various functions within the area. This will lead to a ranking in the popularity of various area compositions based on the location typology.

Besides the preferences of end-users, which is the central aspect of this research, key figures for the added value potency will be attached to each functional composition. This makes it possible to also make a basic analysis on the financial aspects of the functional compositions. In this way a tool will be developed which will allow parties who are active in spatial development, to make decisions regarding the function mix of inner-city train station locations based on both market potential (demand) and financial yields.

**1.5 | Hypothesis**

In this research there is focused on two aspects of the power forces within urban area developments, as mentioned in figure 1. This focus on market demands and financial interests has led on the following hypothesis:

*The area composition with the highest appreciation of end-users will not per definition be the most feasible one.*

In theory, a high appreciation should translate into a high demand. The latter should, under a well functioning market, result in a higher price which should provide a better feasibility. This theory leads to a vicious circle in which ‘the market’ corrects its imperfections or imbalances automatically. (Schutte, 2002) Based on this theory, the area composition with the highest appreciation could lead to the highest feasibility. However, this theory is based on well functioning and transparent markets. Real estate markets are most of the time not well functioning, often there is an imbalance between demand and supply caused by the construction time of building projects. Besides that, most real estate markets are not transparent because not all information is shared or accessible.
Based on the latter two aspects, it is expected that there will be a quite long processing time which is needed to translate the preferences into prices and to attune the supply to the demand. Because this research is a just a snapshot of the current situation, it is expected that there will be a discrepancy between scores of the area compositions based on the preferences of end-users on the one hand and the feasibility on the other. This because of the fact that the preferences of end-users in this research are state of the art information. On the contrary, feasibility figures are always based on recent transactions and are therefore always lagging behind on preferences.

Another reason why it is expected that the area composition with the highest appreciation of end-users will not per definition the most feasible one is that the interests of parties who are active in spatial development will not always be the same as the interest from end-users. The interests of end-users will most probably relate to other aspects (o.a. transportation, urban vitality and diversity, synergy advantages and agglomeration effects) than those of the parties who are active in spatial development (o.a. complexity, costs/revenues, risk). Dobbelsteen & Wilde (2004) Coupland (1997) Cheah (2010) Jacobs (1998) Priemus(2000) Tomari (2006)

Within the research, a division regarding to type of end-user is made. The division will be described in more detail in chapter two. This division is based on the assumption that the preference patterns for area compositions will differ per type of end-user. Per type of end-user hypothesis will be stated regarding the preferred presence levels (medium, high or low, see chapter two for a detailed explanation of these levels) of the functions within inner-city train station locations. Regarding to residents it is assumed that they want a solid living environment which can fulfill their daily needs. Therefore it would seem logical that social amenities and retail could have a good score within this population typology. Besides that, it is assumed that they want to live with people that have the same interest. Because of this the residential function could also be preferred. Residents will avoid functions which can provide annoyance as much as possible, therefore it would make sense that leisure functions could be less preferred. This has led to the following hypothesis:

Residents will prefer housing, amenities and retail at a high preference level in a inner-city train station area. Leisure will be less preferred under residents in inner-city train station areas.

In relation to organizations it would seem plausible that they would like to have other companies situated near them in order to benefit from synergy advantages and agglomeration effects. Hoppenbrouwer & Louw (2005) Former research of Graaff (2005) has shown that there is a high absolute willingness to pay under employees, working within train station areas, for retail facilities (in specific supermarkets). This would seem logical based on the convenience of shopping while employees are commuting to or from their work. Based on the above aspects the following hypothesis have been defined:

Organizations will prefer offices and retail at a high preference level in a inner-city train station area.

When looking at visitors of inner-city train station areas, it can be said that they will not come to the area to work or to reside/stay. The most probable desired uses are therefore leisure, retail and social amenities. Based on the frequency of use of the functions within an average life pattern it is expected that retail is the most desirable function for this end-user typology. This has led to the following hypothesis:

Visitors will prefer retail at a high preference level in a inner-city train station area.

Regarding to investors, the financial figures are seen as the most important criteria considering the expectation of the most preferred uses in inner-city train station areas. When looking at the added value of the different uses (see appendix 8), residential and office uses will have the most added value (highest residual land value). This has led to the following hypothesis:

Investors will prefer retail and housing at a high preference level in a inner-city train station area.

When looking at the total research population (all types of end-users) it is expected, considering the above hypothesis, that retail will be most preferred on inner-city train station developments. This because retail is expected to be preferred in high presence level by multiple types of end-users. Retail will most probably be followed by housing. The presence levels of other functions are expected to differ much per type of end-user, it is therefore expected that they are preferred at a medium level by the total research population. Therefore, the following hypothesis has been defined.

The total population will prefer retail and housing at a high preference level on inner-city train station locations. Office, leisure and social amenities are expected to be preferred at a medium level.
1.6 | Research Design

1.6.1 | Methodology & Techniques
The main aim of the research is to gain insight in the preferences of end-users for multiple functional compositions. In order to get that insight several steps have to be taken. The most important steps will be addressed in the following. An in-depth discussion of the research methodology & techniques can be found in chapter three.

First of all, an explorative literature survey will be conducted in which the concept of mixed use will be explored and defined within the research context. Besides this the explorative literature study will be used to make an overview of the currently known advantages and disadvantages of mixed use.

Secondly, the appropriate method to measure ‘preferences’ will have to be investigated. This will be done in the in-depth literature survey. The in-depth literature study will focus on how to measure the concept of ‘preference’ in relation to ‘mixed use’. Out of all the possible options that are mentioned in the literature (see chapter two) we have made a choice for the best method which we will use in the following step. The next step will be the design of the research which will be based on the methodology option that is chosen, which is that of stated preference research. Within this method respondents are asked to choose between two options (discrete choice) in a hypothetical situation. This in order to get to know their preferences. This research option will be applied with the use of a case study.

More specific, by means of making a visualization of variants with different functional compositions which will be projected on the same location (the case study). By asking respondents which visualizations they prefer, an optimal variant can be found. Besides that, the preference for individual functions can also be derived. The preferences can be derived for both the total population and specific sub-groups.

1.6.2 | Research Design
The research design is presented on the next page. This is done by linking the activities and results to the phasing and research questions. The research design is divided in four parts: activities, results, research questions and phasing. These parts are linked together so that it can be seen which activities and results will have to be conducted or delivered at a certain time. In the left column the research activities are shown. Within these research activities a basic pattern is stated by means of the green arrows. This might look like a quite static process but in practice this process will most probably be more iterative.

The second part of the scheme shows the results that have to be delivered, this part of the scheme is linked to the right part of the scheme which shows the global research planning. In this way it can be seen when particular products have to be delivered. The green dotted lines reflect the formal moments (peilingen) in the graduation process. The red horizontal lines represent the holidays.

When looking at the total graduation process design, the activities which take most of the time are the theory part, in which two literature studies are conducted, and the design of the questionnaire. Because these activities will take most of the time in the research process, they will be explained in the following. Within the theory part, an explorative literature study and an in-depth literature study are conducted which involve a lot of reading and critical reflection time. These literature studies are used for the development of the theoretical framework of the research.

The part in which the questionnaire is designed consumes a lot of time due to the development of the statistical model which determines which visualizations have to be combined in a choice set in order to be able to analyze the desired effects. Besides that, all the visualizations will have to be designed and rendered. After that, a web-based questionnaire has to be developed which has to be send to respondents. Besides all the activities that are shown, the writing of the graduation thesis is also an important aspect. This activity is not mentioned in the scheme but there is aimed at maintaining writing process the during the whole graduation process. In this way a gradual development of the thesis will take place.
Formulation of research subject & first ideas

Research subject
- Research subject
- Draft research proposal

What are the current theories regarding mixed use?
- Feed back & improvements P1
- Explorative research study
- Final research proposal

How can user preferences regarding to mixed use be measured and taken into account?
- Feed back & improvements P2
- In-depth literature survey

Definition of mixed use & first ideas regarding research method

Theory 'Mixed Use'

Theory on measuring preferences

Choice for research method & operationalization of main concepts

Choice for a case study
How can the preferences of end-users regarding the functional composition of a station area be measured?

Which functional composition will have the highest appreciation from the end-users of a multifunctional station area development?

Is there a connection between the type of end-user and the appreciation of the functions within the area?

Will the functional composition with the highest preference also be the most interesting one seen from a financial perspective?
CHAPTER 2: THEORETICAL FRAMEWORK
The goal is to research the generic preference patterns for this specific location typology in relation to the functional composition. This refers to the following phrase out of the definition of mixed use:

“...within a determined space...”

What we want to test in this research is how several functions are appreciated on the selected location typology. This location typology should therefore have the potential for the development of multiple functions. In relation to this, Lau (2003) refers to critical aspects in determining the possibilities of locations for mixed use to occur. These critical aspects can often be found in urban areas. More specific, the metropolitan urban area is the most interesting area typology to use as case study. The metropolitan urban area is characterized by its intensive and multiple use of space in the presence of high-end public transport. The area can be reached within 1 to 3 kilometers of an intercity or regional train station.

Due to the recent (re-) developments of train station areas, which gives this area typology a high contemporary value, and the match with the aspects described in the above, we have chosen train station areas as the area typology for this research. Regarding to train station locations, a demarcation has been made towards intercity (IC) train stations in a central urban situation (inner-city). The focus will be on a national level (The Netherlands).

With regard to location typologies, Eck & Koomen (2008) state three important aspects. First of all there is the spatial scale. Secondly there is the thematic scale. And at last there is the extent.

### 2.1 Definition of Mixed Use

In this research the concept of mixed use is defined by the presence of several physical functions within a determined place. Since there is no standard in mixed use, there will be worked with a dynamic definition of mixed use.

In the above the definition of mixed use which will be used in this research is given. This definition is quit broad and therefore certain aspects of the definition will be described in more detail below. The aspects that will be described in more detail are stated in chronological order. This is done because the decisions regarding the demarcation of certain aspects have influence on other aspects, therefore it is important to know what the sequence in the departure points of the research process is.

#### 2.1.1 Definition of the concept space

First of all, a certain area typology for a case study is chosen. This is done because there is aimed at developing insights in generic preference patterns for the functional composition within urban area developments. Because it is assumed that these preferences differ per location typology, a specific location typology is chosen.
Spatial scale
In relation to the first aspect, the spatial scale, the following can be said: the higher the scale level, the greater the possibility for mixed use to occur. In relation to this, Berghauser Pont & Haupt (2005) describe several scale levels that can be useful in relation to scale, especially for selecting the location typology.
First there is the island level: “In most cases the island will simply be a collection of lots. Sometimes, however, it will also contain public areas (tare space) such as playing fields, public car parks and green space. An island is limited by the borders of the transport infrastructure surrounding it. In places where no relevant transport infrastructure is present, a border is constructed between the lots and green areas or water.” (Berghauser Pont and Haupt, 2005: 63)
Secondly there is the fabric level: “The fabric consists of a collection of islands and the transport infrastructure surrounding these islands (tare space). The urban fabric is limited by borders drawn centrally along transport corridors relevant to the scale of measurement. In places where no relevant transport infrastructure is present, a border is constructed between the lots and green areas or water.” (Berghauser Pont and Haupt, 2005 p. 64)
And at last there is the district level: “This entity is composed of a collection of fabrics and large-scale non-built areas (tare space) not included in the fabric itself, such as parks, water and larger transport infrastructure.” (Berghauser Pont and Haupt, 2005 p. 64)
An overview of the levels can be seen in figure 3. Since this research has a focus on urban area developments, the island level will be too small considering the average size of urban area developments. The focus will therefore be on fabric/district level. These levels contain the scale level that provides enough possibility for mixed use to occur. The exact scale level is determined by the case study that will be used in this research, this case study will be further described in paragraph 2.1.2.

Thematic scale
The thematic scale is described by Eck & Koomen as the typology of uses. This comes down to which area functions will be taken into account within the research, which leads to the following phrase out of the definition of mixed use:

“...several physical functions...”

A selection of area functions has been made which will be used to demarcate the research. This selection is based on the estimated realistic possibility and chance that a certain function can occur at (or in other words: matches) the area typology of the selected case study.

For instance: an agricultural function would not match with a metropolitan urban area typology.

The classification of area functions has been made on a global level. Detailed typologies are not taken into account because they would make the research too complex due to the fact that there would be too much variables to take into account. For instance: the function of urban living could be split up in more detailed typologies like rent or ownership, apartments or detached houses, etc. However, the latter –more detailed- typologies do not add value to the main aim of the research which is to get insight in the preferences for the (mix of) area functions in a certain location. Regarding this aspect the focus is not on getting insight in the preference between detailed typologies but on the insight in the preference between different functions in headlines. For instance: the question is not whether an end-user prefers semi-detached housing or apartments but if he prefers housing or offices in a certain location.

Due to the focus described in the above there will have to be worked with average typologies that reflect a certain area function. The average typologies that match the best with the selected case study will be chosen. For instance: apartments will match a metropolitan urban area quite well whereas villa’s or farmhouses would seem less suitable to represent the residential function in this area typology. So in this example a choice for apartments as a typology to reflect housing would seem to be logical. The average function typology should give end-users a good impression of the area function in general without creating value judgments regarding to architectural aspects. However, the end-users should get a sense of what the different functional compositions will do with the area.

Based on Rodenburg and Nijkamp (2004) and the report on spatial policy of Amsterdam (2008) the following functions have been defined:

<table>
<thead>
<tr>
<th>Function name:</th>
<th>Definition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Living</td>
<td>Defined as the space that is needed for living</td>
</tr>
<tr>
<td>Office</td>
<td>Refers to the space that is used to facilitate office activities.</td>
</tr>
<tr>
<td>Retail</td>
<td>Refers to the space that is used to facilitate retail or commercial activities. (shops, department stores, etc.)</td>
</tr>
<tr>
<td>Leisure/entertainment</td>
<td>Commercial exploitation of spare time activities. (restaurants, hotels, bars and pubs, etc.)</td>
</tr>
<tr>
<td>Social amenities</td>
<td>Includes non-profit, care and educational organizations (hospitals, schools, etc.)</td>
</tr>
</tbody>
</table>

► Figure 4: Framework of urban functions
Extent

Eck & Koomen define the extent as the study area. In this research a choice is made for a specific case study. This choice is based on the selected area typology. The case study is used to test several functional compositions (area ensembles) and will be part of the study area. By testing these functional compositions on one location, value judgments due to differences regarding location can be filtered out of the research. This is done because a location will always be unique and the focus of this research will be on the area composition, not on the (surrounding) area characteristics.

However, this research aims at gaining insight in generic preference patterns for the selected location typology. In order to get this insights, there is aimed at visualizing the case study in a way in which it is clear which location typology it reflects. The unique location characteristics will be left out as much as possible in order to make more generic conclusions for the selected location typology ‘an sich’ possible. To make this possible, the case study is used as a ‘blank layer’, on which multiple compositions will be projected in order to research their popularity. The surroundings of the area are also taken into account, but only in relation to the urban situation, this in order to clarify the area typology in which the area compositions will be projected. In this way, the case study together with its direct surroundings in the urban situation will form the study area.

As explained before, this research has a focus on area functions and their mutual composition. However, these functions and their mutual composition are influenced by the surroundings. But because the research aims to derive the preferences for area compositions purely based on the potential for the area typology ‘an sich’, the surrounding functions of the case study are not taken into account. Otherwise, the preference patterns will be influenced by the surrounding functions. In one single urban area development case in practice this would be useful. This in order to attune the supply to the demand, specified for a specific location and its urban context.

But in this research, in which we want to develop generic knowledge of the preferences for inner-city train station locations in general, the influence of surrounding area functions will not be useful because this will defer per location. So if the functions in the surroundings of the case study are involved in the research, this will influence the research and decrease the possibilities to develop generic statements for the function mix of the selected area typology. Therefore, the surroundings of the location are only taken into account regarding to their urban design. This in order to clarify the area typology in which the case study is situated.

Regarding to the extent, it can be said that a laboratory experiment is used within this research. The location typology is isolated from its surrounding area functions and the preference patterns for various area ensembles are researched ‘an sich’ within this isolation. As said before, within this laboratory approach it is important that the location typology is known but that the unique location characteristics (of the surroundings) are left out of the research.

In figure 5 the ‘laboratory’ approach can be seen. The case study/development area (luminous) is used a ‘blank layer’ and the surroundings (grey) are worked out on urban design level. On the development area of the case study several area compositions will be projected in order to test their popularity. The functional composition of the case study will be the focus of the research and will be variable, whereas the surroundings, the train station en the railway will be regarded as fixed.

► Figure 5: Laboratory approach: visualisation
2.1.2 | Case study

In order to enable a valid and pure comparison of the preferences of end users for several functional compositions we will choose one case study on which the several functional compositions will be projected. In this regard, the case study should provide enough possibility for mixed use. But how can it be judged if a certain location provides enough possibility for mixed use? This will be discussed in the following.

As mentioned before, Lau (2003) refers to critical aspects in determining the possibilities for mixed use developments, the most relevant ones are stated below:

1. Residential density and development intensity;
There has to be a possibility to create a certain amount of gross floor area that makes it possible and interesting to develop several functions on one location. A certain density is needed for optimal interaction between several functions, synergy advantages could be optimized in this way. This should however fit within the environment.

2. Land use;
Regulations and zoning plans should enable enough possibilities to develop several functions on a location.

3. Transport modes and pedestrian links;
If a location has a good accessibility, the catchment area of functions will be expanded. In this way the accessibility can determine the success of a mixed use development.

The above aspects can be reduced to the main characteristics of mixed use locations, which are: intense use and experience, multiple functions and supporting facilities. These characteristics can often be found in urban areas. In the following we will try to specify the type of urban area which has the most potential for multifunctional area developments and is therefore the most interesting area typology regarding the case study for our research.

The most interesting area typology to use as case study is the metropolitan urban area. The metropolitan urban area is characterized by its intensive and multiple use of space in the presence of high-end (public) transport. The area can be reached within 1 to 3 kilometers of an intercity or regional train station.

The above characteristics have led to the choice for inner-city IC train station locations as central area typology. The contemporary value of this subject has made it relatively easy to find a suitable case study. The case study that is used within this research is ‘Stationskwartier Breda’. This case study meets all the criteria stated in the above. The case study reflects an urban area development concerning approximately nine hectare. This area is situated directly near the intercity train station of Breda. Therefore it reflects exactly the area typology which is central in this research. The whole area of the case study will be completely redeveloped. This equals the ‘blank layer’ approach which is used in this research. This case study is chosen because the data that is needed for the research is available via the graduation company and the case study is going to be developed in the coming years, in this way the research results could be useful for the specific case study in practice. The case study is part of the urban regeneration plan ‘Via Breda’. This plan is divided in several sub-developments situated around the inner-city train station of Breda. In this way, ‘Stationskwartier Breda’ forms a central point within the total urban regeneration plan.
2.1.3 | From ‘blank layer’ to ‘spatial program’

In order to be able to visually design the different functional compositions some departure points will be needed. In this regard the proper spatial ratios in relation to the chosen type of location will be important. The program ‘Spacemate’ can help to determine these ratios. The application helps to find important aspects (like density and urbanization) related to the type of location. It is a fine instrument for making the translation from the quantitative aspects of mixed use into the qualitative aspects, which will be needed for the visualization of the area compositions:

“It clearly sets out the linkage between densities on the one hand and land development, urbanization and non-built space on the other.” (permeta architects, 2010)

When it comes to measuring urban typologies Berghauser Pont & Haupt (2005) provide the aspects stated in the following:

1. **FSI (Floor space index)**

To obtain this index the total GFA (Gross Floor Area) is divided by the PA (Plan Area), see figure 8. The FSI expresses the built intensity of an area.

2. **GSI (Ground space index)**

In order to obtain this index, the BA (Built Area) is divided by the PA, see figure 9. The GSI expresses the compactness of an area.

3. **OSR (Open space Ratio)**

The OSR is obtained by dividing the PA minus the BA by the GFA, see figure 10. The OSR expresses the openness of an area and the pressure on the non-built space.

4. **L (Layer)**

In order to obtain the amount of layers, the GFA is divided by BA, see figure 11. L expresses the average number of floors in an area.

The aspects stated in the previous serve as departure points for designing the functional compositions. Spacemate combines these ratios in a graph (see figure 12 & 13 ), which makes it possible to indicate which ratios fit (or belong to) a certain area typology. In this way a design framework can be made which matches the selected location type: a metropolitan train station area.

On the basis of the selected ratios and the area size of the case study a spatial program (built area, un-built area, mass, density, footprint, etc.) can be developed. This spatial program will determine the total amount of m2 GFA that is possible, based on the average ratios for the selected area typology.

The spatial program has been combined with the basic departure points of the current urban design for ‘stationskwartier Breda’. This in order to make a design that fits within the urban context. Based on the combination of the spatial program of spacemate and the current urban design, a spatial design is developed for the ‘blank layer’. This process is reflected in figure 14.

Now that the global spatial design and the amount of possible GFA is known, it is desired to know how the amount of square meters GFA should be divided amongst the several possible area functions in order to create a program that has the highest market potential. This will be discussed in the following paragraph.
Figure 8: Floor Space Index (FSI)

Figure 9: Ground space index (GSI)

Figure 10: Open Space Ratio (OSR)

Figure 11: Layers (L)

(Permeta Architects, 2010)

Figure 12: Framework of ratios

Figure 13: Area typology

Figure 14: From 'blank layer' to 'spatial program'
2.1.4 | Functional compositions

Based on the spatial program, that is discussed in the previous paragraph, the area functions of paragraph 2.1.1 will be divided over the area. These area functions will have to be visualized in order to be projected on the case study. The visualization of the area functions can be seen in figure 15.

For each area function, a standard typology has been chosen which reflects the area function. This is a difficult aspect because value judgments regarding the appearance of the visualization could distract the attention of the focus in this research, which is on whether the area function ‘an sich’ is desired or not. In this way, the focus should not be on the appreciation of the appearance of the visualization. Therefore we want to exclude value judgments regarding architectural aspects of the buildings as much as possible. However, recognition has to be created for each function typology. In order to create this recognition, there has been tried to select building forms that reflect the most basic elements of each function typology.

Since the spatial design of the previous chapter already has determined the average building height which suits the case study, there will not be much variation regarding to building height. The building form will also be kept as basic as possible. An exception is made for the retail function, which is represented by means of a mall. This mall needs to have a large form in order to be recognized as a mall. In this way it deviates from the other building forms, which are approximately the same size.

The difference in function typologies will therefore be mainly expressed thru the façade and the colors/materials of the buildings. As said before, there is tried to keep these expressions a basic as possible in order to prevent strong value judgments regarding to architectural aspects of the visualisations.

With the five area functions presented in figure 15, a lot of functional compositions can be made. The research aims at testing these different functional compositions within the design framework of the selected location. Because not all of the possible functional compositions can be tested, a demarcation will be made into three presence levels per area function.

The amount of presence of the area functions is divided in three categorical variables: high, medium and low/no presence. This still gives possibilities to make a lot of variations, which makes the definition of mixed use dynamic since there are a lot of (mixed use) variations possible with the area functions in combination with the described levels. This relates to the following phrase of the definition of mixed use:

“...dynamic definition...”

In order to make the research less complex, some demarcations have been made which will be described in the following.

Percentages are attached to presence levels of the area functions, see figure 17. This figure shows an example of the possible levels by means of the function social amenities. All the other functions have the same options regarding to the possible levels. Combinations will be made with the different functions and their three levels. This will result in several area compositions, which will be tested regarding their popularity under end-users.

The percentages of the function levels are applied to the spatial design of the previous paragraph. They reflect how the functions are dived over the spatial design. An important restriction is that the spatial design will have to be used to its full potential, in this way the total of all functions should be 100 % at all times. In the following, some other restrictions will be described.

There will always have to be four functions present (level medium or high). At the same time, there has to be one function which is not present. The latter makes it possible to derive which functions are not at all preferred by ‘the market’. Another demarcation is that there can be only one function with the level high, which makes it possible to derive which functions are highly preferred by ‘the market’. These two demarcations lead to the fact that the other functions have to contain the level medium.

There is one exception on the demarcations stated in the above. That is the composition in which each area function has the medium level. Regarding to the concept of mixed use, this is the reference composition. In this composition each area function is equally represented, which creates the highest level of mixed use that is possible within the research approach (see figure 18).

The amount of presence of the functions in the area will varied in a systematical way in order to be able to derive the preferences for the possible area functions. This will be discussed in more detail in chapter 3.

The demarcations described in the above are not only made in order to reduce complexity but also because there is a case study used in the research that has to be developed to its full potential (the whole area has to be used). Besides that, the levels (high, medium, low) need to be constant (they need to contain the same values regarding square meters) in all compositions. Regarding the placement of the area functions within the case study there has been tried to work with a fixed place for each area function as departure point. This in order to make it clear which changes occur at the different compositions. The departure positions of the area functions have been based on the composition in which each function has the medium level (figure 18). Based on this composition, functions have been shifted dependent on their level (high/low) in a certain composition. Examples of functional compositions can be seen in figure 19 & 20.
2.2 | Definition of End-user

Within this research, end-users are defined as the people that are going to use an area with its build structures. This research aims at the development of results that are useful for parties who are active in the practice of spatial development. Therefore the concept of end-user is seen from the perspective of parties who are active in the spatial development practice. Due to the multiple area functions that have been defined in the previous, also several types of relevant end-users can be distinguished. The different types of end-users will be described in the following. Together they will form the research population or ‘market’.

The different end-users are defined in figure 21 & 22. They are selected based on their relevance for parties in the spatial development practice. Residents and organizations are direct customers, they can buy (or rent) buildings. Visitors are not direct costumers, however they can determine the success of area functions who are dependent on visitors. Therefore they will have influence on the way that an area will work and that is why they are important. Investors are also direct customers, they can purchase buildings (or even whole developments).

The reason why several types of end-users have been distinguished is to create the possibility to make crosslinks between the type of end-users and their preferences. The end-users which have been described in figure 21 & 22 will be used as respondents in this research. This in order to test their preferences for the various area compositions. In this way it is not only possible to develop statements regarding the preferences of the whole population but also for the specific types of end-users. This can be usefull when there is worked with specific target-groups. It can also help to determine an optimal combination of different types of end-users which combine well in an area, based on their preferences.
In this chapter the research method will be discussed. It will be explained why this method is chosen. After this, the design of the discrete choice model and the online questionnaire will be discussed.

3.1 Introduction
What we want to know in this research is how (potential) end-users of real-estate objects perceive certain compositions of multifunctional area developments. In this regard concepts like acceptation and experience are important. This research has a spatial-economic orientation and the focus will be on the influence of the functional composition of a multifunctional area development on the acceptation or experience of that area development by end users. The main goal is to search and explore trends or average preferences in the choice behavior of end users. In this way there is aimed at getting insight at global preference patterns in the initiative phase of an area development. In this way, areas can be developed with compositions that are based on market demand in order to achieve that they will be occupied quickly to prevent vacancy. This can be seen in figure 23. In this figure a strongly simplified reproduction of the influences on the experience and acceptation of an area by end-users is shown.(based on Berkhof, 2008: 22) In this research we will focus on the area characteristics, in particular on the influence of the functional composition of an area on the experience and acceptation of the area by end-users. In this regard it is good to look at how the global process of the development of an area takes place. The development often starts with ideas and concepts which can be combined in a vision for the area. Often these visions are based on arbitrary, personal opinions of what is good for the area and own interest could also play a role. Besides that, restrictions and requirements also play an important role. Our research focuses more on market research, which is also an important factor in the initiative phase. However, market research is not always used. In particular not when there is a sellers real estate market (more demand than supply). If nonetheless market research is used, it is often based on historical data of different projects. However, in the current time of rapid changes, state of the art information is needed. Therefore, it is desirable to predict the acceptation or experience of certain functional compositions of areas. In this way the demand of the ‘market’ can be taken into account in the initiative phase of area developments. This creates possibilities to develop areas that match the market demand. The latter is very important in the current situation of a buyers real estate market.

Since multifunctional area developments are central in this research, there won’t be a focus on a particular kind of end user because multifunctional area developments per definition have several kinds of end-users. The interesting thing about these multiple end-users is to research if there are differences in preference and how these (possible) differences can be combined into one area. After all, an area that satisfies as much end-users as possible is the most sustainable one. It has a strong right of existance due to the support of its end-users.

3.1.1 Choice out of the relevant methods
As mentioned before, the goal of this research is to get insight in the preferences of (potential) end-users of real estate objects regarding the composition of multifunctional area developments. In order to get this insight we have to collect research data which allows us to make analysis and conclusions.

In order to get the desired insights in the preference patterns of end-users, a quantitative research approach seems to be the best option. Bogerd (2009) states that there are several ways to collect research data about the appreciation of certain goods or situations.

It can be done by means of “stated preference” and “revealed preference”. Revealed preference methods determine the appreciation of certain goods on the basis of behavior that has been shown. The general concept behind this method is that consumers (in this research end-users) show their appreciation by means of their acting (purchasing acts). In this way, the preferences are always based on historical data. This could be an disadvantage for the research if state of the art information is needed. The advantage of this technique is that a lot of factors can be taken into account, therefore this technique can be seen as a complete way to study the problem. However, this also leads to greater complexity. Besides that, it is hard to isolate the mixed use characteristics due to correlation with other preference determining characteristics which decreases the reliability of the research results.
Within *stated preference* methods a person is asked for his or her preference. Starting point is a hypothetical situation in which consumers are asked to state their preference. With this method it cannot be guaranteed that the person in question will act in the exact same way in actual practice as in the hypothetical situation. However, the advantage of this method is that it is suitable to research a specific subject that would be hard to isolate or separate in price-based revealed preference models. This type of research also enables ex-ante analysis of products or services that are not on the market yet. A disadvantage is that it is hard to take into account the broad location factors like region and city and as already said before, there can be a difference in what end-users say that they would do and what they actually do. (Kuhfeld, 2005)

Based on the aspects that will be described in the following, a choice for stated preference methods has been made. First of all, there is the fact that parties who are active in spatial development are in particular interested in gaining insight at preferences of potential end-users in the initiative phase of projects. In this way they can translate the market demands into their plans. If a revealed preference method would be used to gain this insight, the research would be based on historical data, which can be aged or not relevant for the specific location. Therefore, revealed preference methods would seem less suitable.

Secondly, a quite specific subject is researched: the influence of the functional composition of multifunctional area developments on the appreciation of the (possible)end-users. Within revealed preference methods it would be hard to isolate this specific subject. Due to the complexity of the method, a specific focus is therefore hard to realise. (Kuhfeld, 2005) In this way, a choice for stated preference methods would be more logical because it enables to test a very specific product or subject that is not on the market yet. The complexity of reality can be reduced to a more simple hypothetical situation in which a specific subject can be researched, independent of other variables. In this way, stated preference research is the most suitable research approach for a laboratory experiment.

### 3.1.2 Stated preference methods

Within stated preference methods there are two concrete methods of collecting the research data; by means of direct surveys and indirect surveys.

Direct surveys are also known as the Contingent Valuation Method (CVM). In this method respondents are directly asked towards their acceptability of changes in their direct environment. For example, a person can be asked what he or she want to pay for a certain product. Respondents could make strategic choices because they think that they could profit themselves. The latter is a disadvantage of direct surveys; there could be a difference in what people say they would do and what they will do in practice (Kuhfeld, 2005).

Indirect surveys contain a short representation of a hypothetical situation which is confronted to the respondents in order to get their opinion about a certain product or situation (Kuhfeld, 2005). This method attempts to quantify qualitative information. The use of choice sets prevents strategic answers and therefore reduces the chance on social desirable answer behavior. This increases the validity of the research. Because of the ability to quantify qualitative information (we want to test several situations which can be seen as qualitative information) and the prevention of social desirable answer behavior there has been chosen to use indirect survey methods.

### 3.1.3 Indirect surveys

Within indirect surveys there is a distinction between ‘conjoint analysis’ and ‘discrete choice analysis.’ Within Conjoint Analysis the respondent ranks a certain hypothetical situation. Discrete choice analysis differ from Conjoint Analysis because there is no ranking involved, a choice is made between two or more ranking.
more alternatives. Breiderd (2006), quoted in Bogerd (2009), states that the process of choosing between two alternatives is a better representation of actual practice than ranking or marking a certain product or situation. Because we want to simulate the actual presence as good as possible in this research and we want to prevent personal difference (the way in which a ranking scale is perceived can differ per person), we have chosen for discrete choice analysis in stead of conjoint analysis.

An overview of the choice-path that has been made regarding to the research method can be seen in figure 24. In the following paragraph we will discuss the discrete choice method in more detail.

3.1.4 | Discrete choice Method

As stated in the previous, an interesting research method to investigate preferences regarding the composition of multifunctional area developments is ‘discrete choice modelling’. Discrete choice modelling experiments enable researchers to model choice in an explicit competitive context, thus realistically emulating market decisions. It is used for understanding people’s stated choice among alternatives. (Kuhfeld, 2005)

Within discrete choice models several attributes (area functions), which are expected to have influence on the choice behavior of respondents, are varied and presented in two (or more) sets of product alternatives (area compositions) to respondents. Bogerd (2009) states that the ideal number of attributes comes down to six (minus or plus two) attributes. This is based on the fact that respondents have limits regarding to the storage en processing of information with which they are confronted during a limited time.

In a discrete choice study, attributes (area functions) are varied and presented within sets of product alternatives (area compositions). A discrete choice study uses an experimental design to create sets of products alternatives and respondents are asked to choose the most preferred alternative from each set. Out of the choice between the alternatives the utility of the separate attributes (area functions) can be derived. The area function with the highest utility could be seen as the most preferred function.

3.1.5 | Designing and analyzing the choice sets

In order to get valid research results the design and analysis of the choice sets will be very important. The use of software to support the design and analysis processes is therefore useful. In the following the software program SAS will be discussed.

SAS provides several methods for analyzing marketing data which enables analysis on purchasing decision trade-offs, display product positioning, and the examination of differences in customer behavior.

“Market research focuses on assessing the preferences and choices of consumers and potential consumers.” (Kuhfeld, 2005: 35)

An important step in conducting valid research is an experimental design. An experimental design is a plan for running an experiment. The attributes (area functions) of an experimental design are the columns or variables that have two or more fixed values, or levels (high, medium, low). The rows of a design are called runs and correspond to product profiles (area compositions).

Experiments are performed to study the effects of the attribute levels on the dependent or response variable. Kuhfeld(2005) mentions full-factorial design as all possible combinations of the levels of the attributes. However he states one important disadvantage of this method: “The problem with a full-factorial design is that, for most practical situations, it is too cost-prohibitive and tedious to have subjects consider all possible combinations.”

For this reason, researchers often use fractional-factorial designs, which have fewer runs than full-factorial designs. The price of having fewer runs is that some effects become confounded. Effects are confounded or aliased when they are not distinguishable from each other.

The challenge of our research will be to create an as small design as possible, because of the limited time and budget, but with a good reliability. What you want in the design is orthogonality and balance. What you need is good stability. Efficient designs can give you what you need. This is very well summed up by Mick Jagger and Keith Richards: “You can’t always get what you want, but if you try sometimes, you just might find, you get what you need!” (Jagger & Richards,1969)

Due to the possibilities that software like SAS provide, efficient choice designs can be made. The attribute levels can be varied among the choice sets in a very efficient way. Because of this not all of the possible combinations between the attributes and their levels have to be served to the respondents in order to get valid research results.

When it comes to analyzing the data of discrete choice models Bogerd (2009) describes several effects. First of all there are the main effects. A main effect is the effect of a certain attribute on the total preference, given the average values of the other attributes in the model. Secondly there are first order and higher order interactions. In higher order interactions, three or more attributes influence each other simultaneously. In first order interactions only two attributes influence each other. Interactions are possible with both attributes and external factors (like respondent characteristics such as age or type of end-user). Out of all the observations the utility value (or use) of the attributes can be determined. The utility value represents the importance that the respondents grant to the attributes. It is represented by SAS as the ‘parameter estimate’. Besides this, it is possible to look at the ‘probability of choice’ which reflects the most popular level of the attributes. This is based on a derivative of the ‘estimated utility’.
3.2 | Design of the research
In the research relevant end-users will be approached by means of an online questionnaire. In this questionnaire several area compositions will be shown to the respondents. This will be done by means of two visualizations of area compositions (choice options) in a choice set. Each respondent has to fill in several choice sets. Based on the choices that are made, preference patterns can be derived. How these choice sets and the questionnaire are designed will be discussed in this paragraph.

3.2.1 | Design of the discrete choice model
As described in chapter two, this research will use five possible area functions (urban living, office, retail, leisure, social amenities). Each function can have three levels (high/medium/low). A lot of area compositions can be made with the variations of these 5 functions with their 3 levels. The software program of SAS will be used to make an efficient design, so that not all the possible variations will have to be presented to the respondents in order to derive their preferences.

In the following we will use some terms which are used within the SAS software to illustrate specific aspects of the research in more detail. In SAS the area functions are called attributes, these attributes can have three levels. The unique combinations (functional compositions) which can be made with the different attributes and their levels are called product alternatives. With 5 area functions, which can have 3 levels, 243 product alternatives can be made. This amount will be too much to present to all the respondents. Therefore some restrictions will be made in order to create a more efficient design.

In the situation without restrictions, as described in the above, it would be possible that not the whole area is developed. Because this in not desired (the whole spatial program has to be used) we have developed the restriction that a product alternative should always use 100% of the spatial design. Percentages are attached to presence levels of the area functions (high = 40%, medium=20%, low=0%). These percentages are based on the spatial design which has been discussed in the previous chapter. They reflect how the functions are dived over the spatial design. In this way the total of all functions should be 100 % at all times. Another restriction is that there will always have to be four functions present (level medium or high). At the same time, there has to be one function which is not present. The latter makes it possible to derive which functions are not at all preferred by ‘the market’. Another demarcation is that there can be only one function with the level high, which makes it possible to derive which functions are highly preferred by ‘the market’.

These two demarcations lead to the fact that the other functions have to contain the level medium. There is one exception on the demarcations stated in the above. That is the composition in which each area function has the medium level. Regarding to the concept of mixed use, this is the reference composition. In this composition each area function is equally represented, which creates the highest level of mixed use that is possible within the research approach.

The restrictions in the above reduce the amount of possible product alternatives out of which respondents can choose. However the amount is still too high to present all the possible product alternatives to the respondents. To cope with this issue SAS will be used to produce an efficient design which reduces the amount of possible product alternatives that has to be presented to the respondents. The amount of presence of the functions in the area will varied by SAS in a systematical way in order to be able to derive the preferences for the possible area functions. The software will determine which product alternatives will have to be combined in one choice set in order to create the most efficient design with the lowest amount of product alternatives.
The actual most efficient design that has been produced by SAS has brought the amount of choice alternatives back to 15 unique alternatives. These 15 alternatives are divided amongst 15 choice sets with two alternatives. This most efficient choice design can be found in appendix 3. The visualizations which are used to represent the product alternatives contain a lot of information, which has to be processed by the respondents. In the pilot questionnaire this appeared to be too much information to handle for the test population. Since the 15 choice sets are the minimum amount that is needed in order to produce significant and reliable results, there is no possibility to reduce the amount of choice sets. Therefore, there has been decided to split the 15 choice sets in 3 blocks, each consisting out of 5 choice sets. These blocks are randomly assigned to each respondent. In this way, each respondent will only have to make 5 choices instead of 15, and therefore the amount of information which has to be processed will be reduced. The blocks can also be seen in appendix 3.

3.2.2 Design of the questionnaire

The design of the discrete choice model had to be visualized in a questionnaire in order to present it to the desired target group. This has been done by means of a web-based (online) questionnaire. This questionnaire has been mailed to the network of the graduation company. This network contains both companies (business relations) as well private persons (customers/buyers). The case study, as described in chapter two, will be presented in the questionnaire. This will be done by means of a video. After this video, the respondent will be asked how he sees himself in relation to the described case study. The respondent is able to choose out of all the selected end-user typologies of this research (see chapter two). In this way he is forced to view the area form a perspective that will suit him most. This gives the possibility to make an analysis of the preference patterns based on the total research population as well as on the specific type of end-user. Based on the choice regarding to the type of end-user, some background questions will be asked to get some more detailed information regarding the type of end-user.

There has been tried to make the product alternatives as recognizable as possible for the respondents. This has been done by means of creating a ‘vignet’ which contains a visualization of the specific product alternative combined with a numerical representation (percentages) of the product alternative. An example of this ‘vignet’ can be seen in figure 25. The ‘vignets’ are presented beside each other in sets of two. Respondents have to make a choice between the two vignets in each choice set. Each respondent will have to fill in 5 choice sets. The total questionnaire can be seen in appendix 4.
4 | Research results

In this chapter the actual research that has been done will be discussed. In the first paragraph the research population will be discussed. Thereafter, the research results will be discussed. First for the total research population and thereafter specified towards end-user typology. In the last two paragraphs the placement of the area functions and the concept of added value are discussed.

4.1 | Research population

In this research, a questionnaire has been used to determine preference patterns of end-users regarding the functional composition of an inner-city train station area development. A web-based questionnaire has been used which has been send by e-mail. In appendix 4, the total questionnaire is shown. In figure 26, it can be seen that 534 respondents have klicked on the e-mail invitation and 406 respondents have actually started the questionnaire, of which 178 respondents have finished the total questionnaire.

The end-user is a central aspect within this research. It is therefore important that all the different types of end-users, as described in chapter two are approached. This has been done by using the relation network of the graduation company combined with own acquisition of relevant mail addresses. The estimation was that the combined research panel should have the potential to represent enough respondents for each end-user typology. This has been monitored during the research. In figure 27, the composition of the research population can be seen, dived towards the end-user typology. This division is derived from a question within the questionnaire. After the presentation of the case study (video) the respondent has been asked how he sees himself in relation to the described location. The respondent was able to choose from four options, which has resulted in the division which can be seen in figure 27. This division is interesting because it shows from which angle respondents have the most interest in the location. Therefore it shows a first glance of the potential of the location. For each end-user, different characteristics are interesting to research. Therefore, each type of end-user has been confronted with different background questions. The most important aspects will be discussed per type of end-user in the following. More detailed information about the research population, per type of end-user can be found in appendix 5.

4.1.1 | Residents

In total, 21 respondents (12% of the total research population) have filled in the questionnaire from the perspective of resident. When looking at these 21 respondents some interesting aspects can be observed, the most important aspects will be discussed in the following. The resident population mainly exists out of male respondents. Most respondents are married and are living in a combined household. The income division is quite dispersed over all categories. The income category > 50.000 is the most represented category (29%). Most of the residents have a higher education degree (57%). The province of Noord-Brabant is most represented under the residents (76%). This could be explained by the location of the graduation company and its local focus.

4.1.2 | Organizations

There are 34 respondents (19% of the total research population) who have filled in the questionnaire based on the perspective of an organization. When looking at these 21 respondents some interesting aspects can be observed, the most important aspects will be discussed in the following. The resident population mainly exists out of male respondents. Most respondents are married and are living in a combined household. The income division is quite dispersed over all categories. The income category > 50.000 is the most represented category (29%). Most of the residents have a higher education degree (57%). The province of Noord-Brabant is most represented under the residents (76%). This could be explained by the location of the graduation company and its local focus.

4.2 | Research results

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activities is also well represented (35%). Regarding to the size of the organizations, which is in this research measured by full-time equivalents, it can be said that there is much variation in size. The categories of <20 FTE and >100 FTE are the most represented categories, with respectively 38 and 32 percent. Regarding to the business sector in which organizations are active, it can be said the category of financial services is most represented (50%).

4.1.3 | Visitors

With 107 respondents (60% of the total research population) who have filled in the questionnaire from the perspective of a visitor, the visitor is the most represented end-user typology within the total research population. It is expected that most travelers see themselves as a visitor of the area. Because of the intercity train station, the area could be attractive for travelers, which could be explain the high amount of respondents who look at the location from the perspective of visitor. When looking at the gender of the visitors, it is interesting to see that there are again more male than female respondents. However, the difference is smaller compared to the resident population. Respectively 66 percent male against 44 percent female. Considering the age, it can be said that the visitor typology represents a relatively young population. The category 20-40 is the most represented age category (55%). Regarding to the income of the visitors, the higher segment is well represented (35% >50.000).

Because the typology of visitor has a broad scope, we have asked the respondents why they would visit the area. This makes a more detailed analysis possible. When looking at motives for visiting the location, a first indication for the potential of certain area functions can be derived. Figure 28 shows that leisure activities (hotels, cinemas and theaters) form the most important motives to visit the area. This is remarkable considering the expectation that a lot of travelers would see themselves as visitors. This is why it is expected that the end-user typology of visitors will contain a lot of travelers. Based on this, the expectation would be that a lot of visitors want to spend their spare time in the area when they have to wait on a transport connection. Therefore, the expectation is that the time that they will stay in the area will not be very long. Leisure, on the contrary would seem a function for which people could come to the area and for which they would stay a longer time. It would seem plausible that travelers prefer retail above leisure because of the reason stated above. The fact that leisure is preferred above retail could indicate that end-user typology of visitors is not dominated by travelers but that it also exists of people who would especially come to the area to visit specific functions. It would seem plausible that real estate functions related to leisure could perform well based on figure 28. However, this preference is only based on the end-user typology of visitors. In the following paragraph we will analyze the preference based on the whole research population. Nonetheless, the preferences of visitors are important due to the potential of the location for this type of end-user, as can be derived from the amount of respondents that have chosen the visitor perspective (Figure 27).

4.1.4 | Investors

If the concept of end-user is seen for a ‘neutral’ perspective an end-user could be described as someone who makes use of the area in everyday life. In this regard an investor could not be seen as an end-user. However, in this research the concept of end-user is seen from the perspective of parties who are active in the actual development of urban areas. Within this perspective, the concept of end-user has been defined more broader and includes all the clients who purchase, rent or use the real estate that is developed in the area developments. In this regard, an investor is also seen as an end-user. There are 16 respondents (9% of the total research population) who have filled in the questionnaire based
on the perspective of an investor. When looking at the type of investor, it is interesting to see that most investors are private investors. Respectively 75% private investors against 25% institutional investors. Most investors are active on national level (38%). The average invested value is approximately 756,500,000 euro.

### 4.2 Preferences of the total population

#### 4.2.1 Preference for the area composition

In the questionnaire people are asked towards their preferences regarding the area composition by means of two methods. The first methods is a direct question on how much (a variable percentage) of each function should be present in the area. This has been worked out by means of a scrollbar with which respondents can select the desired percentage of presence per area function (figure 29). Within this approach there is asked a lot from the imaginary abilities of the respondent. This is why the second approach is developed, in which a respondent can choose between two visualized options. This is the main research approach on which is focused within this research. In this method, the visualization is made for the respondent so he does not need to do that himself, which can simplify the choice. By seeing two different options beside each other, the respondent should be able to see differences better. In this way it should be easier for him to detect where his preferences lie. However, to reduce the amount of compositions that had to be visualized, some restrictions have been used. These restrictions result in three possible presence levels per area function. The latter enables finding more detailed percentages of the desired presence levels of the area functions.

#### Direct method

The result of the first option is shown in figure 30. When looking at this figure it can be seen that the retail function is the most popular function (26% presence) followed by office (23% presence) and leisure (19% presence). The residential use and amenities are less preferred, respectively 18% and 14% presence. However, when looking at these percentages it can be noticed that there are no very large differences in the preferred presence levels between functions. Regarding to this, it can be concluded that all functions are, on average, desired. This confirms the mixed use potential of the location typology. The advantage of the option which is used in figure 30 is that much freedom is given to the respondent to state his favorite amount of presence per function. This has led to the average values of figure 30. However, it is also possible to look at the range of the preferred presence levels per function. The range contains the minimum and maximum presence levels per function, which have been stated by respondents. When looking at the range of average values in figure 31, retail is the only function that respondents always want to have in their favorite composition (the lowest level is 10% percent presence). All the other values have a lowest value of zero. Retail also has the highest highest value (80% presence). Retail is followed by office and residential with respectively 60% an 50% presence as highest value.

#### Discrete choice method

In the second option which has been used to determine the favorite area composition, predefined presence levels have been used which have been varied in a systematical way over the five possible area functions. The levels high, medium and no presence where varied between functions in order to create different area compositions (real estate programs). This under the restriction that there should always be one function
with the level ‘high’ and one function which has ‘no presence’. This forces people to make more ‘extreme’ choices which enables to derive clear preference patterns for the several area functions. The above has resulted in 15 unique area compositions. These compositions where visualized in ‘vignets’. Respondents have been asked several times to choose between two ‘vignets’. Based on these choices the popularity of the vignets and the individual functions can be estimated by means of the ‘probability of choice’. This enables a ranking of the 15 area compositions based on their probability of choice which enables to say something about the popularity of the different area compositions. The vignet with the highest probability of choice is shown in figure 32. This vignet contains retail as main function and has no presence for the function of amenities. This corresponds with the results of the ‘direct method’ in figure 30, in which retail is the most desired function and amenities is the least desired function. Figure 33 represents the least preferred vignet based on the probability of choice. This vignet contains the office function as main function and the leisure function has no presence. The ranking of all the vignets, based on their probability of choice can be seen in appendix 6. Based on the total range of the probability of choice values, the area compositions have been categorized in the scores very good, good, average, bad and very bad. The ranking of all the vignets can be seen in appendix 6. Based on the total range of the probability of choice values, the area compositions have been categorized in the scores very good, good, average, bad and very bad. When looking at the top five of this ranking we see that the most preferred function is retail (3 times) or leisure (1 time). The fourth composition in the top five ranking contains an equal division between all the area functions. Regarding to the concept of mixed use, an equal division of functions could be seen as an optimal area composition. That this area composition has the fourth highest probability of choice is again showing the mixed use potential of inner-city train station locations. Seen in an overall perspective the results of both methods seem correspond. However, there are some difference which probably have been caused by the difference of the two research methods.

4.2.2 | Preference for the individual functions
The advantage of the discrete choice option is that besides the preferences for the total area composition also the preferences for the individual area functions can be analyzed. In this way it can be seen which level (high, medium or no presence) is preferred for each individual area function. This will be discussed in the following. First, the utility of each function will be discussed. The utility states the importance that respondents grant to a specific function in relation to the choice that they make for a specific area composition. In other words, the utility states the role that a function has played in the choice behavior of the respondents. This role can be positive or negative. Therefore, a high utility of a function doesn’t per definition reflect a high preference for that function. It only shows that the function has played an important role within the choice for a certain ‘vignet’, which can be caused by both positive or negative preferences. The utility value of each area function can be seen in figure 34. In this figure the area functions are ranked based on their utility from left to right. On the basis of the ranking it can be seen that the function of amenities has the highest utility where the residential function has the lowest utility. Based on this, it can be said that the variation in presence level of amenities matters a lot in the choices of respondents while the variation in presence level of the residential function matters less. Beside the function of amenities, there are no big differences between the values of the area functions. There are no extreme low values. This shows that all area functions have played a significant role within the choice behavior of the respondents. Contrary to the direct method, in which the exact percentages of the desired presence level of each area function can be derived, the discrete choice method forces respondents to choose out of three levels (‘high’, ‘medium’ and ‘no presence’).
‘medium’ or ‘no presence’). This gives a more abstract representation of the preferences of the respondents because the respondents have to make more ‘extreme’ choices. Either a function has a high presence, a medium presence or no presence at all. Because only three levels are used within this approach, it is possible to derive which levels are most preferred. This is done based on the choices that respondents have made. The advantage of the method is that more insight in the structure of the preferences can be obtained. Where the direct method only shows one exact percentage, the discrete choice method allows us to show the appreciation of three levels which can help to indicate what will happen to the appreciation when the presence level becomes higher or lower. In the following the desirability of each presence level will be discussed per function. First, the residential function will be discussed. Looking at this function in figure 35, a clear preference for the medium level can be derived. The second most preferred level is ‘no presence’. Least preferred is the high presence level. This means that a medium level for the residential function is preferred and a deviation from the medium level to a lower presence level is higher appreciated than a deviation to a higher level. This corresponds with the results of the direct method in which the residential function is desired at 18 percent of the total spatial program, which is a bit less than then medium presence level of 20 percent in the discrete choice method. When analyzing the office function in figure 36, it can be seen that there is a clear preference for the ‘no presence’ level. The presence levels have a clear structure, on the basis of which it can be said that the less offices, the higher the preference. This does not match with the results of the direct method. In the direct method, the office function is with a desired presence of 23 percent the second most preferred area function after retail. The difference in preference is most probably caused by difference in the two methods. The visualization of area functions could play an important role within this difference. It could be that visualization of offices did not appeal to the respondents and that they therefore did not prefer the function. This could be in contrary to the method where offices are not visualized and in which therefore the imagination of the respondent has more freedom. When we look at the function of retail in figure 37, it can be noticed that there is a clear preference for the high level of presence. On the basis of the structure of the preferences it can be said that how higher the amount of presence, how higher the preference. This is in line with the results of the direct method in which retail is the most preferred function with 26 percent. Considering the presence levels of the function leisure, which can be seen in figure 38, almost the same preference pattern as the function of retail can be derived. This means that how higher the amount of leisure, how higher the preference. This results in a clear preference for the high presence level. This does not exactly match the results of the direct method, in which leisure has a preferred presence of 19%. However, this 19% is close to the medium level (20%) of the discrete choice method which is the second most preferred level after the high level. Because the difference in preference between high and medium is not that big as with the retail function and because the respondents are forced to make more ‘extreme’ choices within the discrete choice method, the difference between the two methods seems to be in proportion. Regarding the amenities function, a strong preference for the ‘no presence’ level can be derived from figure 39. The preference for the no presence level is very strong, which has resulted in the high utility of amenities in figure 34. Compared to the choice probability of the no presence level the choice probabilities of the other levels of the amenities function are quite low, with a slight higher probability for the medium level. The preference outcome for the amenities function corresponds with the results of the direct method, in which amenities is the least preferred function with 14% presence.
Overall, it can be said that the results of both methods show mainly the same preference patterns. The only functions that do not correspond in both methods are office and leisure. It is expected that the different approach of the two methods has caused this difference. Both methods have their advantages and disadvantages. In the direct method the advantage is that the exact amount of desired presence can be determined since there are no pre-defined levels. Another advantage is that the imagination of respondents gets more freedom. However, the latter can also be a disadvantage because it can be questioned if every respondent has the capability to imagine the effects of the compositions that will be created. These effects will be more understandable within the discrete choice option. This due to the visualization which is used within this method. However, this visualization has also a disadvantage, value judgements regarding the appearance of the functions can be made which can influence the research results. Another advantage of the discrete choice method is that it gives a more abstract preference pattern, which makes it possible to see what happens to the preference when a function has a higher or lower presence level. The above differences in advantages and disadvantages show that there is not one single ‘truth’. Because of this, the methods used will be compared and analyzed in order to come to solid conclusions.

4.3 Preferences per type of end-user

Now that the preferences of the total research population have been analyzed, there will be looked at the preferences per type of end-user. This makes it possible to see the differences between the several types of end-users, which can be useful for the determination of end-users which could combine well in an area. First, the desired presence level per type of end-user will be analyzed per individual function which makes it possible to gain insight in the structure of the preferences for each function. This will eventually lead to an optimal real estate program per type of end-user on the basis of the analysis of each function.

4.3.1 Preference for the individual functions

In the following, the preferred presence level of each area function will be discussed, specified towards end-user typology. The preferred presence level will be analyzed based on both the direct method and the discrete choice method. The results of the discrete choice method have been plotted in a bar chart, in which the bars on the y-axis represent the probability of choice of each presence level. A more detailed analysis of the choice probabilities can be found in appendix 7. The possible presence levels are placed on the z-axis. By placing the type of end-user on the x-axis, it is possible to compare the choice probabilities of each presence level of a certain area function per type of end-user. The results of the direct method have been plotted in a line graph which shows the preferred presence (exact percentage) of a certain area function on the y-axis and the end-user typology on the x-axis. The green and blue lines show the highest and lowest observations per type of end-user. In other words, they state the range of the observations. The red line represents the average of all the observations and the light blue and purple lines represent the standard deviation of the average values. First, we will look at the line graph of the direct method in order to get a clear overview of the difference in preference between the several types of end-users. After that, the bar chart of the discrete choice method is analyzed in order to get more insight in the structure of the preference patterns and to compare if both methods correspond with each other. The analysis described in the above will be applied per area function for each end-user typology.

Residential function.

Considering the residential function it can be said the this function is most desired by residents. This can be seen in figure 41, in which residents have stated the highest...
desired amount of the residential function with 35%. This observation has a rather small standard deviation compared to the other end-user typologies, which makes it an extra reliable observation with a relative small change of deviations. What is also interesting to see is that residents always want to have the residential function in their favorite composition, this can be based on the low border (blue line) of 10 percent in figure 41. The other end-user typologies have a low border of zero, which means that the residential function in not always desired in the favorite composition of the other types end-users. Despite the fact that the residential function is most appreciated amongst residents, the function is not desired in a presence level of more than 50 percent. This is based on the high border (green line) of 50 percent. This means that the observation with the maximum amount of presence of the residential function contained 50 percent residential use. When looking at figure 40 in order to gain insight in the structure of the preference patterns for residents, we see a clear preference for the high presence level. Based on the levels of figure 40, it can be said that the higher the presence level, the higher the probability of choice (preference).

When looking at the end-user typology of organizations in figure 41, it can be said that they come second (with 21 percent) in the ranking regarding the appreciation of the residential function. The difference with residents is however quite large (14 percent). The desired amount of presence of the residential function by organizations (21 percent) comes close to the medium level (20 percent) of the discrete choice method. When looking at the latter in figure 40, it is therefore not surprising that the medium level is again the most preferred presence level for the residential function. Looking at the second most preferred level, investors have clear preference for the deviation from the medium level to the high level instead of a deviation from the medium level to the no presence level. Considering the range of the observations for investors in figure 41, it can be concluded that there is a range of 40 percent. The standard deviation is the highest of all end-user typologies regarding to the residential area function, however this standard deviation does not seems to be excessive.

The end-user typology which has the lowest appreciation for the residential area function is that of visitor. Visitors have an average desired presence of 14 percent (figure 41). The observations have a range of 40 percent with a high border of 40 and a low border of 0. The observations have a rather small standard deviation, which is comparable with that of the resident typology. Considering the structure of the preferences in figure 40, it can be said that visitors have a clear preference for the medium presence level and a deviation from this level to the no presence level is higher appreciated than a deviation to a high presence level.

If the structure of the preferences of the total population is compared the structure of the several
individual end-user typologies in figure 40, some interesting aspects can be found. First of all, the end-user typology of residents has a clear deviation from the total population. The resident typology has a clear preference for a high presence level and it can be said that how higher the amount of presence how higher the preference. This is in contrast with the preferences of the total research population which prefers the medium level, after which the no presence level is most preferred. The high presence level is least preferred by the total population. Besides this, another interesting aspect is that the structure of the preferences of the end-user typology of visitors is almost the same as that of the total research population. This could be explained by the relatively high weight of this end-user typology within the total research population, see figure 26.

**Office function**

In relation to the office function, it can be said that organizations desire the highest amount of presence of the office function. This can be seen in figure 43. In this figure it can also been seen that the observations of the end-user typology of organizations have a range of 30 percent, with a low border of 10 percent and a high border of 40 percent. This means that all observations contain at least 10 percent offices and do not contain more than 40 percent offices. Comparing these results to those of the direct method, which is represented in figure 42, shows that there are differences between both methods because in figure 42 the most desired presence level is that of no presence. However, the second most preferred level is the high presence level. This states that organizations prefer a deviation from the no presence level to the high presence level above a deviation from the no presence level to the medium presence level. Therefore the preference seems to be either no presence or a high presence of the office function. The above shows that the fact that organizations have the highest preference for the office function (figure 43) does not automatically lead to a choice for the high preference level in figure 42. However, when comparing the mutual differences between the end-user typologies in figure 42, it can be seen that organizations have the highest probability of choice for the high presence level compared to the other end-users. Compared to the other end-users organizations also have one of the lowest choice probabilities for the no presence level. This could clarify the fact that organizations desire the highest amount of presence of office in relation to the other type of end-users, as can be seen in figure 43.

When looking at the end-user typology of investors in figure 43, it can be said that they come second (with 25 percent) in the ranking regarding the appreciation of the office function. The difference with organizations in the amount of desired presence is very small (only 1 percent). The range of the observations from the investors is 40 percent with a low border of 0 and a high border of 40. The standard deviation seems to be in proportion. When looking at the structure of the preference pattern in figure 42, it can be said that how lower the amount of presence, the higher the appreciation. When looking at the difference of investors with organizations it can be seen that the difference in appreciation of the no presence and medium function is smaller and the appreciation of the high presence level is lower.

The next end-user typology, based on a ranking regarding the preference of the office function from high to low, is the visitor. This end-user comes third in the ranking with a score of 23 percent desired presence of the office function (figure 43). The observations of the visitors have a range of 50 percent with a high border of 50 and a low border of 0. The standard deviation is average compared to the other end-user typologies. When looking at the preference pattern in figure 42, a clear structure can be seen in which how lower the amount of offices, how higher the appreciation.

The end-user typology that desires the lowest amount

► Figure 42: Probability of choice per end-user for each presence level of the office function.

► Figure 43: Desired amount of presence per type of end-user for the office function.
of presence for offices is that of residents. The average of the observations for this end-user typology is 19 percent (see figure 43). It is remarkable that the range of the observations is rather small with just 20 percent. The range has a low border of 10 percent and a high border of 30 percent. This means that all the observations are all relatively close to the average of 19 percent. Therefore it is not surprising that the most preferred level within the discrete choice method of figure 42 is the medium presence level (20%). The residents are the only end-user which prefers the medium presence level above the no presence level for the office function.

If the structure of the preferences of the total population is compared the structure of the several individual end-user typologies in figure 42, some interesting aspects can be found. The preferences of the resident and investor end-user typologies seem to deviate from the preferences of the total research population in that they prefer the medium level considerably higher, within residents its even the most preferred presence level. Looking at the visitors, the preferences patterns are almost exactly the same as those of the total research population which confirms our assumption that the relative high weight of the visitors within the total research population will have a great influence on the preference patterns of the total research population.

Retail function
In relation to the retail function, it can be said that the end-user typology of investor desires the highest amount of presence of the retail function. Remarkable is that the observations of this end-user typology have a quite broad range of 70 percent. This range has a low border of 10 percent and a high border of 70 percent. This means that not all the observations are close to the average of 29 percent. The standard deviation is also quite large, which results in a lower certainty of the average value. When we compare the results of the direct method of figure 45 with the results of the discrete choice method of figure 44, the results do not correspond with each other. In figure 44 the structure of the preference pattern of investors show that how lower the amount of presence of the retail function how higher the preference of investors. Based on this it could be concluded that retail is not desired by investors. This is in contrast with figure 45 in which investors have the highest average value for the desired amount of presence of the retail function. The differences in outcome between the two figures can be explained by the different approach of the two research method, as already explained before in paragraph 4.2.2. It is clear that investors do not desire retail at an high level (the 40% option in figure 44 has the lowest probability of choice) and if investors are forced to make more ‘extreme’ choices, they prefer the no presence level above the medium presence level. However, figure 45 shows that all observations contain at least 10% retail. This shows that retail is always desired by investors. The option of 10% is not available within the discrete choice method which makes an exact estimation of the desired presence level impossible. However the insight in the structure of the preference patterns is on the other side very useful. The fact that the no presence level is preferred above the medium presence level could indicate that the average value of figure 45 is on the high side and therefore the average value should maybe be adjusted downwards, which could be plausible considering the high standard deviation of the average value.

When looking at the end-user typology of visitors in figure 45, it can be said that they come second (with 28 percent) in the ranking regarding the appreciation of the retail function. The difference with investors in the amount of desired presence is very small (only 1 percent). The range of the observations for visitors in figure 45 is also quite large with 50 percent. This range has a low border of 10 percent and a high border of 60. Considering the large range, the standard deviation is much smaller (compared to that of the investor).
When we look at the structure of the preference pattern in figure 44, it can be seen that how higher the amount of retail how higher the preference of the visitors. A strong preference for the high presence value (40%) can be derived, which corresponds with figure 45 which shows an average value of 28 percent which is above the medium presence level of the discrete choice method.

The next end-user typology, based on a ranking regarding the preference of the retail function from high to low, is the organization. This end-user comes third in the ranking with a score of 22 percent desired presence of the retail function (figure 45). The observations of the organizations have a range of 40 percent, with a low border of 10 percent and a high border of 50 percent. When looking at the preference pattern of the organizations in figure 44, it can also be said that how higher the amount of retail how higher the preference of the organizations. However, compared to the visitors the preference for the high level is less clear by the organizations. In other words, the difference in preference between the high and medium level is smaller. Organizations have also one of the highest preferences of the no presence level, compared with the other end-user typologies.

The end-user typology that desires the lowest amount of presence for retail is that of residents. The average of the observations for this end-user typology is 18 percent (see figure 45). It is remarkable that the range of the observations is rather small with just 20 percent and a low border of 10 percent and a high border of 30 percent. The standard deviation is very small, which results in a very reliable average value. Looking at the structure of the preference patterns of figure 44, it can again be said that how higher the amount of presence of the retail function, how higher the preference of the residents. However, figure 44 shows a clear preference for the high presence level (40%) while figure 45 has an average value of 18 percent (which is even under the medium presence level (20%) of the discrete choice method). In this way an upwards adjustment of the average value in figure 45 would seem plausible based on the preference structure of figure 44. However, the standard deviation and the range of figure 45 are very small which indicate that an adjustment would not seem logical. The difference between the two methods should therefore be sought in the different approaches of the two research methods.

If the structure of the preferences of the total population is compared the structure of the several individual end-user typologies in figure 44, some interesting aspects can be found. The investor has an opposite preference pattern compared to the other end-user typologies, which have more or less the same preference patterns. When comparing the results of figure 45, it is remarkable that all the end-user typologies desire the retail function for a presence percentage of at least 10 percent. This means that retail is desired in each observation of each type of end-user.

Leisure function

Regarding the leisure function, it can be said that visitors have the highest amount of desired presence with an average of 21 percent (figure 47). The observations of the visitors have a range of 40 percent with a low border of 0 and a high border of 40. The standard deviation seems in proportion. When looking at figure 46, a clear structure of the preferences can be derived. It can be said that how higher the amount of presence of the leisure function, how higher the appreciation of the visitors.

When looking at the end-user typology of organizations in figure 47, it can be said that they come second (with 16 percent) in the ranking regarding the appreciation of the leisure function. The range of the observations of the organizations is the same as that of the visitors with a high border of 40 and a low border of 0. The standard deviation is a bit larger, compared to the other end-user typologies. Considering the structure of the preference pattern of organizations in figure 46,
it can be said that there is a clear preference for the high presence level and how higher the amount of presence of the leisure function, how higher the probability of choice of the organizations.

The next end-user typology, based on a raking regarding the preference of the leisure function from high to low, is the resident. This end-user comes third in the ranking with a score of 15 percent desired presence of the leisure function (figure 47). This is only 1 percent difference with the end-user typology of organizations. The range of the observations of the residents is with 30 percent a bit smaller compared to that of the organizations. The standard deviation is also smaller than that of the organizations. In figure 46, it can be seen than not the high is less appreciated by residents compared to visitors and organizations. This has resulted in the fact that the medium presence level is preferred above the high presence level. However a deviation from the medium presence level to the high presence level is higher appreciated than a deviation from the medium presence level to the no presence level.

The end-user typology that desires the lowest amount of presence for leisure is that of the investor. The average of the observations for this end-user typology is 14 percent (see figure 47). Remarkable is that the range is quite small with just 20 percent. The standard deviation seems average. When looking at the preference pattern of the investors in figure 46, the same structure as that of the residents can be derived. However, the choice probability for the high presence level is considerably lower which results in a very strong preference for the medium presence level. Furthermore, a deviation from the medium presence level to the no presence level is higher preferred than a deviation from the medium presence level to the high presence level.

If the structure of the preferences of the total population is compared the structure of the several individual end-user typologies in figure 46, some interesting aspects can be found. The preference structure of the total research population has almost the same structure as that of the visitors and organizations. This in probably because the latter two end-user typologies have a quite heavy weight within the total research population and therefore determine a great deal of the outcome of the preference of the total research population. It is clear that the residents and the investors show another preference structure, in which the medium preference level is most preferred. However, because of the small weight of the latter two end-user typologies, the influence of the preferences structures on the preference of the total research population is not that big.

**Amenities function**

Considering the amenities function, it can be said that organizations desire the highest amount of presence. However this amount is only 15 percent, which is not much compared to the highest levels of the other area functions. The range of the observations of the organizations is quite small with 20 percent. The range has a low border of 10 percent and a high border of 30 percent. This means that every observation of the organizations contains at least 10 percent retail. The standard deviation seems to be normal. When looking at the structure of the preferences in figure 48, it can be said that there is a very low probability of choice for the high presence level and the structure shows a clear preference for the no presence level of amenities. In this regard, in can be said that how lower the amount of presence of the amenities function, how higher the choice probabilities. The latter can clarify the relative low percentage of desired presence in figure 49.

When looking at the end-user typology of visitors in figure 49, it can be said that they come second (with 14 percent) in the raking regarding the appreciation of the amenities function. This is a very small difference with the organizations. The range of the observations of the visitors is with 40 percent twice as big as a that of the organizations. The range has a low border of
zero and a high border of 40. The standard deviation seems to be normal and is almost the same as that of the organizations. Looking at figure 48, it can be said that the preference pattern of the visitors is almost the same as that of the organizations. The only difference is that the visitors have a (relative) higher appreciation for the high presence level compared to that of organizations. The next two end-user typologies, based on a ranking regarding the preference of the amenities function from high to low, are the residents and the investors. These end-users come third in the ranking with each a score of 13 percent desired presence of the amenities function (figure 49). First, we will look at the residents. The observations of this end-user typology have a range of 20 percent, with a low border of 0 and a high border of 20. The standard deviation seems in proportion. Regarding the structure of the preferences, which can be seen in figure 48, it can be said that there is still a clear preference for the no presence level. However, a deviation from the no presence level to the high presence level is preferred by residents above a deviation from the no presence level to the medium presence level. In this way, it can be derived that the resident prefers no presence of the amenities function or a high presence of the amenities function. The observations of the investors show the same results regarding the range and standard deviation as the residents (see figure 49). When looking at the structure of the preference pattern in figure 48, we see a similarity with the residents. However, the appreciation of the high presence level is higher which has resulted in the fact that the amenities function is not present in most optimal area compositions. This makes it remarkable that investors prefer that function a high level in their optimal area composition. The leisure and residential function seem to be a constant factor, both functions are present at 20 percent in the favorite composition of each end-user typology. Another remarkable fact is that the office function is not present at the favorite area composition of the investors and visitors. Looking at the discrete choice method, it can be noticed that multiple functions could be preferred at a the same level (for example ‘high’ or ‘low’). In this way, multiple functions can have the high or low level when they are analyzed separately. However, if the separate functions are combined into an area composition or real estate program, the total will have to be 100 percent at all times. So, given the restrictions which have been imposed, only one function can have the overall it can be said that the no presence level has a high probability of choice amongst all end-user typologies. Considering the total of figure 49, it is interesting to see the differences between the average values regarding the desired amount of preference of all end-user typologies are very small, just 2 percent. The means that all the end-user typologies are unanimous about the amount of presence of the amenities function.

4.3.2 Preference for the area compositions

In figure 50 the optimal area compositions (real estate programs), specified towards end-user typology can be seen. These compositions are based on the choice probabilities of the area compositions as derived from the discrete choice method. When analyzing figure 50, it can be said that the retail function has a dominant presence in plenty of the optimal area compositions. The only composition in which retail does not has a dominant presence is in the favorite composition of the investors. It is also interesting to see that the amenities function is not present in most optimal area compositions. This makes it remarkable that investors prefer that function a high level in their optimal area composition. The leisure and residential function seem to be a constant factor, both functions are present at 20 percent in the favorite composition of each end-user typology. Another remarkable fact is that the office function is not present at the favorite area composition of the visitors and investors. Looking at the discrete choice method, it can be noticed that multiple functions could be preferred at a the same level (for example ‘high’ or ‘low’). In this way, multiple functions can have the high or low level when they are analyzed separately. However, if the separate functions are combined into an area composition or real estate program, the total will have to be 100 percent at all times. So, given the restrictions which have been imposed, only one function can have the overall it can be said that the no presence level has a high probability of choice amongst all end-user typologies. Considering the total of figure 49, it is interesting to see the differences between the average values regarding the desired amount of preference of all end-user typologies are very small, just 2 percent. The means that all the end-user typologies are unanimous about the amount of presence of the amenities function.

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level of high and only one function can have the level of low. Therefore the method is able to proportion the preference patterns in order to be able to derive which preference patterns are the strongest. This enables to get a more abstract insight into the optimal area compositions. The discrete choice method gives a more simple impression, this in contrary to the direct method which gives a more detailed insight, in which exact percentages can be derived and therefore a more precise insight of the optimal compositions can be obtained which is more dynamic compared to the predefined levels of the discrete choice method. In the following we will discuss the difference and equalities of both methods per type of end-user.

Equalities
When looking at the total research population, it can be derived from both research methods that the retail function is the function of which the most amount of presence in the area is desired. Therefore it can be said that this is the most preferred function. In this regard, it can also be said that amenities are the least preferred function under the total research population. Considering the residents, it can be said it is clear that the function of amenities is least preferred and that for the leisure and office function a medium presence level is desired. Regarding the organizations, it can be said that it is clear that in both methods the function of amenities is again least preferred. The residential and leisure function are in both methods preferred at a medium presence level by organizations. When looking at the visitors, the retail function is most preferred in both methods. Furthermore the leisure function is preferred at a medium presence level. Besides that, both methods don’t indicate amenities as the least preferred area function for visitors. Looking at the investors it can be said that both methods show a preference for a medium presence of the leisure and residential functions.

Differences
Due to the predefined levels the results of the discrete choice are a bit more ‘extreme’ than the results of the direct method. This can be seen when looking at the results for the total research population. Figure 50 states very clear that that the retail function is most preferred and that the amenities function is least preferred with no presence. Figure 51 states exactly the same, but on a more ‘subtle’ way. Here you see that retail is indeed the dominant function, but not as dominant as the 40% level of the discrete choice method. It can also be seen that amenities is indeed the least preferred function but that this function is still desired at a certain level and not at the no presence level. Considering the end-user typology of residents it can noticed that the preferred levels of the residential function differ per method in the ideal composition of residents. This is caused due to the restriction that only one function can have the high level in the discrete choice method. If we analyze the residential function separately (see figure 52), we see that for residents the high level for this function is desired. However this is also the case for the retail function. The high presence level of the latter has a higher probability of choice and is therefore a stronger preference above the high presence level of the residential function. Considering the fact that only one function can have the high level, residential is reflected as medium is stead of high. Regarding
the residents there is one more difference between both methods. In the discrete choice method of figure 50 a clear preference for the high level of retail can be derived which cannot be found back in the direct method of figure 51. Since this difference is not caused by the predefined levels or restrictions of the discrete choice method, the only reason that could cause the difference is that respondents were attracted to the visualization of the retail function in the discrete choice method which could have caused a higher score than when they have to let their own imagination determine the visualization of the retail function in the direct method. Regarding the end-user typology of organizations there can be observed that there are differences between the results of the two research methods in the preference for the office and retail functions. The office function seems the dominant function under organizations in figure 51. However, this is not the case in the discrete choice method in figure 50. When we analyze this function separately within the discrete choice method (see figure 52), the no presence level is even the most preferred level. Therefore the cause for the difference will probably have to be sought in the difference between the appreciation of the visualization of the office function in the respondents own mind within the direct method. For the higher appreciation of the retail function in figure 50 than in figure 51 the same reason as already explained within the analysis of the residents has probably caused the difference. The main difference between the two methods when looking at the visitors is that the office function is the least preferred function within the discrete choice method while it is preferred at a medium presence level in the direct method. This will most probably be caused by a more negative judgment of the office function in the discrete choice method due to the possible negative impact of the visualization of the office function. When looking at the end-user typology of investors it can be seen that the function of amenities is higher appreciated within the discrete choice method than within the direct method. It is expected that this is again caused by the visualization. Because the amenities function is visualized by means of a hospital, it could be the case that investors were attracted to this visualization considering the current popularity of care related real estate under investors. Again, the office function has a lower appreciation in the discrete choice method than in the direct method. This seems to be caused by a systematical negative appreciation of the office visualization in the discrete choice method. Remarkable is that the investor is the only end-user typology which appreciates retail at a medium presence level instead of a high presence level within the discrete choice method. However, in the direct method retail is still the most preferred area function.

4.3.3 | Preference for the placement of the area functions

Now that the amount of desired presence per function (and per end-user typology) is analyzed, which has led to optimal area compositions specified towards end-user typology, it is also interesting to look at a global indication of how these compositions or real estate programs should be arranged within the area. Therefore, the favorite placement of each area function has been analyzed per end-user typology in figure 54. In this figure you can see per sub-area the amount of percentage of the respondents that desires a certain function at that sub-area. There are 5 sub-areas, which can be seen in figure 53. When looking at the residential function it can be noticed that there is a clear preference for a placement in area 1. The preference pattern is quite unanimous amongst all end-users. Regarding to the placement of the office function, the total research population prefers area 5. Residents and organizations prefer area 2 for the office function, where investors prefer area 3.
area 4. Regarding the retail function, there is a strong preference for placement in area 2 by the total research population. The same preference is unanimous amongst all end-user typologies. Looking at the leisure function, a slight preference for placement in area 4 can be derived for the total research population. The resident and investor typologies deviate from this preference with a preference for the placement of the leisure function in area 3. Regarding the function of amenities, the total research population desires a placement in area 3. Residents and visitors desire placement in area 4 and investors in area 5. Based on the analysis of figure 54 the optimal arrangement attuned to the end-user typology could be derived. For the total research population this would come down to the following arrangement of figure 55. The arrangement should be seen as an global indication on area level. The question whether the functions should be mixed within the sub-area and in which way is not taken into account within this research since this could be a research an sich.

4.4 | Added value per area composition

In this research, beside a preference analysis of the area functions, also a land development analysis for the area functions is made to analyze the added value of the several area compositions. “This land development analysis is a direct application of the underlying premise of market value, which is that land value is a function of its highest and best use.” (Lusht, 2001)

Added value is seen from the perspective of parties who are active in spatial development. Because the focus of this research is on urban area development, added value is seen from an area perspective instead of a single property or building perspective. It relates to the creation of financial value (market value minus the development costs) of the different area functions in an area. In this way the added value for a whole area will be determined based on the functions that are developed on that area. In other words, the value of the area is determined by the functions that are developed on it. In this paragraph the functional compositions will be ranked based on their added value. This is done by means of the residual land value of the compositions. This is a method which estimates the land value based on the program that is developed on it. In this research this represents the land value of the of the case study based on the functional composition that is projected on it. When analyzing the residual land value of the different area compositions, there will be aimed at a ranking based on the principle of ‘highest and best use’ of the area under the assumption ‘as if vacant’. Within this approach there will be looked at the composition which has the highest combined land value of all the functions in the area composition. This land value maximizing composition is called ‘the highest and best use’ of the area. (Lusht, 2001)

The residual land value is determined by the market value minus the development cost of a function. This difference states the value of the land, given the determined market value and development costs. This value is determined per square meter per function. The starting points which have been used to determine the residual land value can be seen in appendix 8. The determined square meter values per function are attached to the amount of square meters of the several functions within a certain area composition. In this way a residual land value per area composition will be determined. This makes it possible to rank the compositions based on their residual land value. This residual land value indicates the added value of the different area compositions.

Who will benefit from this added value depends on negotiations and ownership situation, however in this research the analysis of the residual land value is used for an indication of the added value potency per area composition.

Regarding to the principle of ‘highest and best use’ some remarks can be made. Restrictions can be encountered in practice which are not taken into account within this research. For instance, a area composition has to be legally and physically possible. It has to meet zoning

<table>
<thead>
<tr>
<th>Function</th>
<th>Favorite placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Area 1</td>
</tr>
<tr>
<td>Office</td>
<td>Area 5</td>
</tr>
<tr>
<td>Retail</td>
<td>Area 2</td>
</tr>
<tr>
<td>Leisure</td>
<td>Area 4</td>
</tr>
<tr>
<td>Amenities</td>
<td>Area 3</td>
</tr>
</tbody>
</table>

► Figure 55: Overview of the favorite placement per function based on the total research population.
plans. In this research legal and zoning aspects are not taken into account since the market wishes (end-user preferences) are the main focus. Besides this, the financial consequences of public space are also not taken into account within the research. However, it can be said that how higher the added value, how more room there is for investments in public space. The results of this research should therefore be translated within the context and restrictions of the development practice. However, the starting point is that end-user preferences should be leading and that the restrictions and laws should be attuned as good as possible to these preferences in order to create area developments that have a broad support under the end-users of the area.

Based on the principle of ‘highest and best use’ the ranking of area compositions in appendix 8 has been defined. Based on this appendix it can be said that the composition which contains retail at a high presence level and where leisure has no presence, is the ‘highest and best use’ for the area.

If the ranking discussed in the above is compared to that of the ranking of the choice probabilities in appendix six, we can compare the ‘added value’ potential with the ‘market demands’. In theory, it could be said that a high market demand could lead to a high added value. To test this, the five most appreciated functions of the ranking of appendix 6 have been compared to the ranking of appendix 8. Looking at the area composition with the highest probability of choice (appendix 6) it can be seen that this composition also has a ‘very good’ score in the ranking regarding the ‘highest and best use’ of appendix 8. Considering the composition with the second highest probability of choice there is no connection with the score regarding the ‘highest and best use’ since this compositions scores a ‘bad’ level regarding to the ‘highest and best use’ potential. Regarding the third composition in the ranking of choice probabilities, it can be said that this composition has a score of ‘good’ in both rankings, in this way there is a clear connection between ‘added value’ potential and ‘market demands’.

The same is true for the composition that comes fourth in the ranking of choice probabilities, however the score level in both rankings for this composition is ‘average’. The last composition of the top five of the ranking of choice probabilities has the ‘bad’ score in the first ranking and an ‘average’ score in the raking regarding added value potential. This is a difference, but a considerable small one. Except for second composition, it can be said that for all the compositions of the top 5 in the ranking of market demands also a high score regarding the added value potential can be derived. However the difference between the added value potential and market demands for the second composition is quite large. Therefore, the theory that a high market demand automatically leads to a high added value potential is not per definition true.

4.5 | Provisionally concluding

Based on the results of this chapter, some preliminary conclusions can already be made which will be discussed in the following. It is clear that retail is preferred in a high presence level on inner-city IC train station locations. As well by the total research population, as amongst the several end-user typologies. Except for investors, which is remarkable considering the good average yields of the retail function. The least preferred area function on inner-city IC train station locations is the function of amenities, this is also true for almost every end-user typology except for the visitors and investors. The latter two prefer a higher amount of amenities, the investors even prefers amenities at a high presence level. However, by the latter two end-user typologies there are differences in the results of the two research methods which have been used. This decreases the ability formulate reliable statements about the latter two end-user typologies regarding the amenities function. Furthermore it can be said that the residential and leisure function are desired at a medium presence level. As well by the total research population, as by each end-user typology. Regarding the office function, there are differences between the results of the two research methods which makes it hard to formulate reliable statement. However, it seems that the medium level is most preferred for this function.

As already discussed in the previous, it can be concluded that there are some systematical differences in the preferences of both research methods. Retail is systematically preferred at a higher level and offices are systematically preferred at a lower level within the discrete choice method compared to the direct method. As explained before, this is probably caused by the difference between the predefined visualization (and the appreciation of this visualization) within the discrete choice method and the own imagination of the respondent within the direct method.

Considering the placement of the area functions, it can be said that there are clear preference patterns. Especially considering the residential function, where a very high preference for sub-area 1 can be derived. Based upon the surroundings of this sub-area, the shape of the building blocks could have played an important role (possible recognition of the residential function). Another very clear preference pattern that can be derived is that of the high preference for retail in area 2. The situation of the sub-area just besides the train station could have played an important role in this preference. This could indicate that travelers have played an important role in this preference, based on the assumption that they would like to have the retail function situated close to the train station.

Regarding the ranking of the area functions based on the concepts of ‘added value’ and ‘market demand’ some connections between the two concepts can be found. However also a few differences could be derived, therefore it cannot be said that a high market demand per definition leads to a high added value.
CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS
5 | Conclusions & Recommendations

In this chapter the conclusions and recommendations based on the research results will be discussed. In the first paragraph, a reflection on the hypothesis is made based on the research results. After that, the main research question will be answered. In the last two paragraphs there will be discussed how the research results could be interpreted and some suggestions for a solid implementation in practice will be given.

5.1 | Reflection on hypothesis

The focus of this research on market demands and financial interests has led to formulation of the first hypothesis:

The area composition with the highest appreciation of end-users will not per definition be the most feasible one.

This hypothesis has been based on the following way of reasoning. In theory, a high appreciation should translate into a high demand. The latter should, under a well functioning market, result in a higher price which should provide a better feasibility. This theory leads to a vicious circle in which ‘the market’ corrects its imperfections or imbalances automatically. (Schutte, 2002) Based on this theory, the area composition with the highest appreciation could lead to the highest feasibility. However, this theory is based on well functioning and transparent markets. Real estate markets are most of the time not well functioning, often there is an imbalance between demand and supply caused by the construction time of building projects. Besides that, most real estate markets are not transparent because not all information is shared or accessible. Based on the latter two aspects, it is expected that there will be a quite long processing time which is needed to translate the preferences into prices and to attune the supply to the demand. Because this research is a just a snapshot of the current situation, it is expected that there will be a discrepancy between scores of the area compositions based on the preferences of end-users on the one hand and the feasibility on the other. This because of the fact that the preferences of end-users in this research are state of the art information. On the contrary, feasibility figures are always based on recent transactions and are therefore always lagging behind on preferences. Another reason why it is expected that the area composition with the highest appreciation of end-users will not per definition the most feasible one is that the interests of parties who are active in spatial development will not always be the same as the interest from end-users. The interests of end-users will most probably relate to other aspects (o.a. transportation, urban vitality and diversity, synergy advantages and agglomeration effects) than those of the parties who are active in spatial development (o.a. complexity, costs/revenues, risk). Dobbelsteen & Wilde (2004) Coupland (1997) Cheah (2010) Jacobs (1998) Priemus(2000) Tomari (2006)

Based upon the research results of chapter 4, it can be said that with 4 area compositions within the top 5 ranking regarding appreciation of area compositions, also a good score can be derived regarding the feasibility or ‘added value’. This indicates a possible connection between a high preference and a high added value of area compositions. However, there is one area composition within the top 5 of which there is clearly no connection between a high preference and a high added value. This is why the first hypothesis will be partially rejected because there are clear suggestions for a connection between a high preference and a high feasibility. However, this cannot be indicated for each case within the top 5 ranking which means that the connection will not always be valid.

Within this research, analysis have been made towards specific end-user typologies. This has been done based on the assumption that preference patterns will differ per type of end-user. In the following, a reflection will be made on the hypothesis which have been formulated per end-user typology. First there will be looked at the residents. Regarding to this end-user typology, the following hypothesis has been defined:

Residents will prefer housing, amenities and retail at a high preference level in an inner-city train station area. Leisure will be less preferred under residents in inner-city train station areas.

The above hypothesis is based on the assumptions which will be discussed in the following. Regarding to residents it is assumed that they want a solid living environment which can fulfill their daily needs. Therefore it would seem logical that social amenities and retail could have a good score within this population typology. Besides that, it is assumed that they want to live with people that have the same interest. Because of this the residential function could also be preferred. Residents will avoid functions which can provide annoyance as much as possible, therefore it would make sense that leisure functions could be less preferred. When confronting the hypothesis of the above with the research results, it can be said that the high preference for the residential function can indeed be derived. The same is true for the retail function. Amenities however, are the least preferred function. A more negative appreciation of the leisure function cannot be found back in the research results. Therefore the hypothesis can be maintained regarding the housing and retail function and rejected regarding the amenities and leisure function.

Regarding to organizations, the following hypothesis has been defined:
Regarding the end-user typology of investors, the following hypothesis has been formulated:

**Investors will prefer retail and housing at a high preference level in an inner-city train station area.**

Regarding to investors, the financial figures are seen as the most important criteria considering the expectation of the most preferred uses in inner-city train station areas. When looking at the added value of the different uses (see appendix 8), residential and office uses will have the most added value (highest residual land value). This has led to the hypothesis stated in the above. When this hypothesis is confronted with the research results of chapter 4, it can be said that the hypothesis can be rejected. In the discrete choice method the retail function even scores a no presence level when analyzed separately. However, in the direct method the retail function is preferred at a quite high level which makes it harder to give an clear statement regarding to this function.

Regarding the function of housing it can be said with more certainty that it is not desired at a high level by investors because both methods prefer the function at a medium presence level.

Based upon the previous hypothesis and assumptions, the following hypothesis for the total research population has been defined:

**The total population will prefer retail and housing at a high preference level on inner-city train station locations. Office, leisure and amenities are expected to be preferred at a medium level.**

This hypothesis is based on the following way of reasoning. When looking at the total research population (all types of end-users) it is expected, considering the above hypothesis, that retail will be most preferred on inner-city train station developments. This because retail is expected to be preferred in high presence level by multiple types of end-users. Retail will most probably be followed by housing. The presence levels of other functions are expected to differ much per type of end-user, it is therefore expected that they are preferred at a medium level by the total research population.

When confronting this hypothesis with the research results it can be seen that retail is indeed the most preferred area function under the total research population. However, residential is preferred at a medium presence level instead of a high presence level. Regarding to the leisure and office function it can indeed be said that these functions are preferred at a medium level amongst the total research population. The amenities function are least preferred amongst the total research population. To summarize, the hypothesis can partly be rejected (regarding the housing and amenities functions) and partly be confirmed (regarding the retail office and leisure function).
5.2 | Answer on the main research question
In this paragraph, the main research question will be answered. This is the following question:

Is there enough potential for mixed-use on inner-city train station locations in the Netherlands to make it interesting for market parties to develop the current theories and policies regarding mixed-use?

To answer this question, the direct method in which respondents have used scrollbars to indicate their preferred presence level per area function is the most appropriate method. This because the discrete choice method works with predefined levels and restrictions and therefore gives a less accurate outcome in comparison with the direct method in which the exact percentages of the desired presence level can be derived. The results of the direct method can be seen in figure 56. When looking at this figure, it can be seen that all the area functions are desired at all times. As well for the total population, as for each specific end-user typology. Figure 56 shows that there are no very large differences. There are no extreme low values for certain functions, the lowest values are at least 10 percent presence. This indicates the mixed-use potential of the location typology. In other words each function is desired at a certain level. This proves that there is enough potential for mixed-use to make it interesting for market parties consider the development of mixed-use location. Going a bit more into depth, the question arises which mix should be developed. In other words, how should the mutual presence levels of the multiple area functions be? Based on the analyses of the individual function levels in the discrete choice method in chapter 4 it is possible to derive conclusions regarding the general preference patterns for the mutual presence levels of the different area functions in inner-city IC train station locations (see figure 57). In general, retail and leisure are most preferred amongst the total research population. The residential function seems to be desired at an medium presence level, where the office and amenities function seems to be least preferred with a highest probability of choice for the no presence level. When we compare the ranking of the preference for the several area compositions in appendix 6 with the ranking of the financial feasibility of the several area compositions in appendix 8, connections between preference and feasibility can be found in most cases. This indicates that there should also be enough potential seen from the feasibility perspective to realize the most desired area compositions. On the basis of the previous, the main research question could be answered in a positive way. This because it appears that there is enough market demand for mixed-use compositions. The feasibility analysis shows that the most high preferred area compositions also provide good scores regarding the financial feasibility.

5.3 | Interpretation of the results
Looking at the discrete choice method, it can be noticed that multiple functions could be preferred at the same level (for example ‘high’ or ‘low’). In this way, multiple functions can have the high or low level when they are analyzed separately. However, if the separate functions are combined into an area composition or real estate program, the total will have to be 100 percent at all times. So, given the restrictions which have been imposed, only one function can have the level of high and only one function can have the level of low. Therefore the method is able to proportion the preference patterns in order to be able to derive which preference patterns are the strongest. This enables to get a more abstract insight into the optimal area compositions. Therefore, the discrete choice method gives a more simple impression, this in contrary to the direct method which gives a more detailed insight, in which exact percentages can be derived and therefore a more precise insight of the optimal compositions can be obtained which is more dynamic compared to the predefined levels of the discrete choice method.
Due to the predefined levels the results of the discrete choice are a bit more ‘extreme’ than the results of the direct method.

When the results of the two research methods which have been used in this research are compared with each other, it can be concluded that there are some systematical differences in the preferences of both research methods. Retail is systematically preferred at a higher level and offices are systematically preferred at a lower level within the discrete choice method compared to the direct method. It is expected that this is caused by the difference between the predefined visualization (and the appreciation of this visualization) within the discrete choice method and the own imagination of the respondent within the direct method. Both methods have their advantages and disadvantages. In the direct method the advantage is that the exact amount of desired presence can be determined since there are no predefined levels. Another advantage is that the imagination of respondents gets more freedom. However, the latter can also be a disadvantage because it can be questioned if every respondent has the capability to imagine the effects of the compositions that will be created. These effects will be more understandable within the discrete choice option. This due to the visualization which is used within this method. However, this visualization has also a disadvantage, value judgements regarding the appearance of the functions can be made which can influence the research results. Another advantage of discrete choice method is that it gives a more abstract preference pattern, which makes it possible to see what happens to the preference when a function has a higher or lower presence level. The above differences in advantages and disadvantages show that there is not one ‘truth’. Because of this, the methods used have been compared and analyzed in order to come to solid conclusions.

5.3 | Recommendations
The research conclusions reflect on end-user preferences regarding mixed use in station areas in the Netherlands in general. The conclusions aim to give insights in trends based on the preferences of end-users. The actual situation can differ from these trends per location under the influence of o.a. the difference in pressure on the local property markets and different location characteristics. The generic results of this research could be translated to concrete cases in practice by matching the preferences patterns of this research with the current supply on a specific location and its surroundings. In this way, it can be determined which (mix of) functions should be developed at a certain location. For instance, this research shows that there is a high demand for retail on the specific location typology. This could be a reason to plead for the development of retail. However, if the direct surroundings of the location already contain much retail of good quality, the demand for retail will become more relative. In this way, the generic research results should be translated to (the context of) a specific urban area development when they are used in practice.

This research has a spatial-economic orientation and has focused on the influence of the composition of a real estate program on the acceptation or experience of an area development by end users. This instead of a focus on the influence of end-user characteristics on the acceptation or experience of an area development. The latter is also of influence on the acceptation or experience of the composition of an area development but belongs more to social science related research which is not our main research field. Besides that, the intellect that determines choice behavior of a human beings is very complicated, even for advanced researchers. Therefore, the results of our research will be relative because social and psychological effects will also have influence on the choice behaviour of respondents. In this way, it could be said that every end user is unique. The same is true for a location. The uniqueness of every location and end-user should be kept in mind when interpreting the results of the research. However, the main goal is to search and explore trends or average preferences in the choice behavior of end users. In this way there is aimed at getting insight at global preference patterns in the initiative phase of an area development. This in order to be able to develop areas with compositions that are based on market demand so that they will be occupied quickly.

The results of this research should be interpreted as preference patterns which could be used for the definition of a global real estate program on a inner-city IC train station locations. The research gives an indication of the desired presence level of several area functions based on the location typology of inner-city IC train station locations. This can be used to create an optimal real estate program for the specific location. The question how the functions should be divided over the area is another research subject and is therefore not taken into account. Research has been done towards to favorite placement of functions on the different sub-area within the case-study. However, the question whether functions should also be mixed within these sub-areas (and maybe even in buildings) and how the mix should be arranged is not taken into account. The latter aspects are more related to urban design, in this way the results of this research could be used as input for o.a. the urban designers of an area development.


Appendix 1:

Exploratory Literature Study
This document contains the explorative literature study which has been written in relation to the graduation thesis of the mastertrack Real Estate & Housing. This mastertrack is part of the master Architecture, Urbanism and Building Sciences at the Faculty of Architecture of the Delft University of Technology (TUD).

In this literature study several literature sources will be used to explore certain relevant themes of the graduation research subject. Per theme a selection of relevant aspects out of the literature sources will be made. Thereafter a critical reflection based on these aspects will be made, which will lead to conclusions for our own research.

In the following pages the theme that will be discussed will first be stated after which a critical reflection of the literature will be made for that specific theme.

Delft, June 2010
**Definition mixed use**

**Aim:** The development of a solid definition of the concept of mixed use within the research context. This in order to be able to clearly explain what is meant with mixed use to third parties. A clear definition of mixed use will probably also help to find a way to measure a degree of mixed use. For the demarcation of the research it is important to make a clear selection of variables that will be taken into account in the determination of the degree of mixed use.

A lot of terms are used in relevant literature to express building plans or projects that contain a mix of functions. The most relevant terms will be discussed in the following after which a definition of mixed use will be formulated. For reasons of clarity mixed use is the only term that will be used in this research to express building plans or projects that contain a mix of functions.

Mixed use can be defined trough the existence of different land uses within one area. However, it could also be defined trough the different functions within one building. With regard to mixed use on building level Tomari (2005) refers to the live-work concept: “This trend started in the 1970s and 1980s, when many urban factories and warehouses in central city locations were converted into residential lofts, with zoning that allowed for the operation of a business as well.” This example still relates to a mix of different ‘uses’ but it is also possible to have a mix within one ‘use’. In this respect Tomari (2005) refers to diverse housing types and ownership situations like single or multi-family houses versus detached or semi-detached houses and rental houses versus privately owned houses.

The examples stated in the above show that it is very important to describe a clear scale level of the research and make a good demarcation of the concept of mixed use. Therefore we will explore concepts like multifunctional land use and multiple land use, which are closely related to mixed use in order to describe the relevant aspects and irrelevant aspects for this research.

Louw & Bruinsma (2006) define three conceptual levels within the mixing of uses. First of all, the intensification of land uses. This refers to mixed use within one ‘use’. For example, different types of dwellings and different ownership situations. The second level contains the increasing diversity in uses by encouraging a compatible mix. The third level involves the integrating of segregated uses by overcoming regulatory barriers, mostly concerned with environmental impacts, noise or traffic. Louw & Bruinsma (2006) and Priemus (2000) refer to multiple land use. This is a concept which is based on mixed use but a bit more extended by the addition of two aspects. First of all the addition of the vertical dimension (high rise buildings or subterranean space). Dobbelsteen & De Wilde (2004) define this as multiple use of land trough stacking different urban functions. Secondly, there is the adding the time aspect (using the same area of land over time for different functions). The latter of these aspects, refers more to the mixing of uses on building level whereas the focus in this research is on area level. Besides that, this extra dimension is hard to measure and does not relate to the definition of mixed use within the research context, therefore it is left out of the research.

Hoppenbrouwer & Louw (2005) state the following about mixed use in relation to related concepts like intensive and multiple land use: “Mixed-use definitions often refer to intensive land use and multiple land use. However, intensity does not necessarily denote mixed-use and can also refer to monofunctional use, while multiplicity implies multifunctional land use and intensive land use.” (Hoppenbrouwer and Louw, 2005 p. 6)
The focus is merely on the mixing of uses, therefore the intensification issues will not be taken into account, except for the selection conditions of case studies. The time dimension will also be left out of the research, as there will be a focus on the mixing of physical structures and not on the mixing of activities within (parts of) buildings.

Another difference between mixed land use and multiple land use, is that mixed land use is mainly used in an urban context, while multiple land use is both used in an urban and rural context.

With regard to sustainability, Dobbelsteen & Wilde (2004) state that it is important to optimize the use of space or land within urban environments. They define the concept of sustainability conform the definition of the World Commission on Environment and Development (1987): “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Dobbelsteen & Wilde (2004) state that optimization of space can be reached in several ways by changes in the functional usage of a certain area. This can be seen in table 1. Within the possibilities stated in this table there are two main concepts. First of all, there is the concept of intensive space use which can be reached by increasing the occupation rate or adding more building layers. This concept has a subjective character because it is always relative in comparison with other reference projects, it is therefore hard to establish a departure point or standard. The second concept is that of multiple space use. “Multiple use of space is a more objectively definable concept: there is a clear difference between a plan with one function and one with more functions (to which the term ‘multiple’ refers). Functions however need to be clearly defined in order to distinguish multiple from singular use.” (Dobbelsteen and Wilde 2004)

The latter concept will be central in this research, therefore further attention will be paid to this concept. There are several dimensions of the concept of multiple space use, which are shown in figure 2. This might seem a bit abstract at first sight, that is why we have added a more concrete elaboration by means of principles for urban planning and building design in figure 1 and 3. In this figure you can see where the focus of this research is trough the green markings.
To summarize, based on all the aspects stated in the above we find the definition of multiple land use by Priemus (2000) the one that best describes the definition of mixed use within this research, this definition is therefore used as starting point in defining the definition of mixed use within this research:

'Multifunctional land use is the implementation of more functions in a determined place in a determined period of time'.

The word implementation in the definition of Priemus relates more to the presence of human activities which are carried out whereas the focus in this research will be more on the physical presence of the uses themselves. With regard to the functions we will use example, annoyance. Therefore it seems more logical to make two separate functions instead of one combined function. Due to the nature and character of the different organizations the same is true for non-profit organizations and shopping facilities. Another remark is that the hospitality business is not mentioned, at least not separated. Considering the relative importance for the urban environment it seems logical to mention this use as a separate function. Furthermore it is useful to make a separation between functions in the un-built area (no vertical erected structures being accommodations) and the built-on area. This will lead to the framework of functions that can be seen in table 2.

Regarding the concept of mixed use, it is important to define the ‘functions’ or ‘uses’ that are taken into account. Rodenburg & Nijkamp (2004) define the following functions/uses:

- **Residential housing.** Defined as the space that is needed for living
- **Commercial/industrial use.** Refers to the space that is needed to facilitate commerce and industry. This includes, for example, office and industry locations.
- **Amenities.** Includes non-profit organizations (hospitals, schools, etc.) as well as shopping facilities.
- **Infrastructure.** Refers to the space that is needed to facilitate movements of goods and persons.
- **Cultural facilities.** Includes areas that are a destination of day trips, stadiums and amusement parks, as well as space consumed by museums and other cultural functions.
- **Water.** Refers, on the one hand, to the space used by rivers, watercourses, lakes and territorial waters having a ‘water management’ function, while, on the other hand, it includes those areas that have a drinking water function, e.g. storage of drinking water, and infiltration areas.
- **Agriculture.** Refers to the space that is needed for cropland, pasture, orchards, vineyards, and horticulture, but also the space needed for intensive, not land-constricted cattle breeding.
- **Nature and landscape.** Refers, in the case of a broad definition, to the space needed to maintain or guarantee the current quality of nature (biodiversity).

A few remarks about the functions in the above can be made when they are placed in the context of our own intended research. Because the focus in this research is on the urban environment with a rather high density, the agricultural function will not be relevant. Furthermore, the difference between the commercial and industrial uses can be quite large in terms of, for example, annoyance. Therefore it seems more logical to make two separate functions instead of one combined function. Due to the nature and character of the different organizations the same is true for non-profit organizations and shopping facilities. Another remark is that the hospitality business is not mentioned, at least not separated. Considering the relative importance for the urban environment it seems logical to mention this use as a separate function. Furthermore it is useful to make a separation between functions in the un-built area (no vertical erected structures being accommodations) and the built-on area. This will lead to the framework of functions that can be seen in table 2.

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### Table 2: Framework of urban functions

<table>
<thead>
<tr>
<th>Built-on Area:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential housing</td>
<td>Defined as the space that is needed for living</td>
</tr>
<tr>
<td>Commercial use</td>
<td>Refers to the space that is needed to facilitate commerce, office locations</td>
</tr>
<tr>
<td>Industrial use</td>
<td>Refers to the space that is needed to facilitate industry, industry locations</td>
</tr>
<tr>
<td>Amenities</td>
<td>Includes non-profit, care and educational organizations (hospitals, schools, etc.)</td>
</tr>
<tr>
<td>Retail</td>
<td>Shopping facilities</td>
</tr>
<tr>
<td>Hospitality</td>
<td>Restaurants, hotels, bars and pubs</td>
</tr>
<tr>
<td>Cultural facilities</td>
<td>Includes areas that are a destination of day trips, stadiums and amusement parks, as well as space consumed by museums and other cultural functions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Un-built Area:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>Refers to the space used by rivers, watercourses, lakes and territorial waters having a ‘water management’ or recreational function</td>
</tr>
<tr>
<td>Water</td>
<td>Refers, in the case of a broad definition, to the space needed to maintain or guarantee the current quality of nature (biodiversity) and environment (spatial quality)</td>
</tr>
<tr>
<td>Nature and Landscape</td>
<td></td>
</tr>
<tr>
<td>Paved public space</td>
<td>Squares, market places, etc.</td>
</tr>
</tbody>
</table>
the functions of the built-on area and the un-built area out of table 2. Regarding the determined place the neighbourhood (urban fabric) scale within urban areas with a high density will be used. As explained before, the time aspect will not be taken into account within this research. This leads towards the following definition of mixed use:

“Mixed use is defined by the presence of several physical functions within a determined place”

2 Demarcation

Aim: Demarcation of the research topic by an exploration into the kind of methodology, scale and types of areas that are best suitable for the research. This in order to be able to select case studies or data on their relevance to conduct research.

With regard to the selection of possible case studies it is important to make good selection conditions. Eck & Koomen (2008) state three import aspects regarding to this issue. First of all there is the spatial scale, which they describe as the grid cell size within their model. Secondly there is the thematic scale, which is described as the typology of uses. And at last there is the extent, which is described as the study area.

The spatial scale in this research will be on neighbourhood level. With the development of a grid cell size, the correct size will have to be found in order to make application and comparison of several cases on neighbourhood level possible. The thematic scale is described before in this text and in table 2. A clear definition of typologies is made there. The extent, or study area will be the urban environment with a high density.

Lau (2003) refers to the following critical aspects in mixed use developments:
1. Residential density and development intensity;
2. Land use and amenities;
3. Form and design;
4. Transport modes and pedestrian links;
5. Local property market and environmental quality

For the selection of case studies aspects 1, 2 and 4 seem to be most useful within this research context. The aspect of residential density and development intensity is useful to reflect the amount of urbanity, as the focus of this research is on areas within an urban environment with a rather high density. This can be done, according to Lau (2003), by looking at the amount of persons per hectare. Another way is that of Visser & Van Dam (2006) who look at the address density.

The aspect of land use and amenities within a determined area is also very important. It would be useful to find a possible option to measure the amount of functions and the percentage of each function in relation to the total square meters of the determined area. Selection criteria can than be made regarding the minimal amount of functions and the percentage of presence in relation to the total determined area.

Transport modes and pedestrian links are crucial for the accessibility and the economical basis of the different uses in the determined area, and therefore in plays a key role in the success of mixed use developments.

Berghauser Pont & Haupt (2005) describe several scale levels that can be useful regarding to mixed use, especially for selecting en comparing different case studies. First there is the island level: “In most cases the island will simply be a collection of lots. Sometimes, however, it will also contain public areas (tare space) such as playing fields, public car parks and green space. An island is limited by the borders of the transport infrastructure surrounding it. In places where no relevant transport infrastructure is present, a border

Appendix 1: Exploratory literature study
is constructed between the lots and green areas or water.” (Berghauser Pont and Haupt, 2005 p. 63) Secondly there is the fabric level: “The fabric consists of a collection of islands and the transport infrastructure surrounding these islands (tare space). The urban fabric is limited by borders drawn centrally along transport corridors relevant to the scale of measurement. In places where no relevant transport infrastructure is present, a border is constructed between the lots and green areas or water.” (Berghauser Pont and Haupt, 2005 p. 64) And at last there is the district level: “This entity is composed of a collection of fabrics and large-scale non-built areas (tare space) not included in the fabric itself, such as parks, water and larger transport infrastructure.” (Berghauser Pont and Haupt, 2005 p. 64)

When it comes to measuring urban density Berghauser Pont & Haupt provide several aspects:

1. FSI (Floor space index)
2. GSI (Ground space index)
3. OSI (Open space index)
4. L (Layer)

These aspects are all combined in the Spacemate, see figure 4. “The four variables are calculated using the same series of data – gross floor area, built area and plan area – and are thus mathematically related. When working with FSI, GSI, OSR and L, it is important to agree how to calculate the underlying values of gross floor area, built area and plan area.” (Berghauser Pont and Haupt, 2005 p. 58)

“The FSI on the y axis gives an indication of the intensity in an area and the GSI on the x axis reflects its compactness. The OSR and L are gradients that fan out across the diagram. Combining these four variables gives every project a unique ‘spatial fingerprint’.“(Berghauser Pont and Haupt, 2005 p. 59)

The spacemate can also be used to make a first selection in area typology as you can see in figure 4.

Appendix 1: Exploratory literature study

<table>
<thead>
<tr>
<th>Condition</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial scale</td>
<td>Grid cell size/spacemate</td>
</tr>
<tr>
<td>Urbanity/density</td>
<td>Persons per hectare/address density/spacemate</td>
</tr>
<tr>
<td>Amount of mixed use</td>
<td>MXI (mixed use index)/Herfindahl index</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Amount of public transport options and quality of road network</td>
</tr>
</tbody>
</table>

The factors stated before have led to the selection conditions for possible case studies stated in table 3.
Variables for research model
In their text ‘de prijs van de plek’ Visser & Van Dam (2006) describe the results of their research on the influence of the characteristics of the living environment on the real estate prices of dwellings. A detailed view on the value determining factors is given, which can be of use for the selection of variables in the model of my own research. However it should be taken into account that this study is focused only on residential real estate properties whereas the research that I want to conduct will focus more on an area level with several types of real estate properties. Nevertheless, Visser & Van Dam (2006) address some important variables and make some interesting methodological and theoretical conclusions which will be discussed in the following.

A main conclusion of the research of Visser & Van Dam (2006) is that the characteristics of the living environment determine the real estate prices for more than 50 percent. In order to come to this conclusion the following value determining variables have been taken into account:

- Physical building characteristics (m2, façade, type of building, etc.)
- Physical characteristics of the living environment (percentage green, percentage water, etc)
- Social characteristics of the living environment (cultural and economical: social status, demographical development, interest rates, inflation)
- Functional characteristics of the living environment (distance to public transport, accessibility of jobs)

Another factor that is mentioned quite often is the influence of local market circumstances. This factor is related to several of the above mentioned variables and has been taken into account in the research by measuring the discount rates of transactions and the availability of work within an acceptable distance/time (as a reflection of the pressure on the local housing market).

The variables stated in the above could also form a starting point for application on area level instead of building level. With relation to mixed use the physical and functional characteristics will be the most crucial ones. However, Visser & Van Dam (2006) state as one of their methodological conclusions that it is important to take as much variables as possible into account during the analysis. A hedonical price analysis based on only few variables will be doomed to fail because the relative importance of these variables will be overestimated.

The variables stated in the above are clusters which contain other, more detailed variables. It would go too far to mention them all in this literature survey, but there is however one detailed variable that is quite interesting in relation to function mix. This is the address density, which could serve as a reflection of urbanity. Considering the fact that mixed use is often related to intensification of the urban environment, the address density could be a good selection criteria for case studies.

Research method:
In their study on the influence of the characteristics of the living environment on the real estate prices of dwellings Visser & Van Dam (2006) state three main methods in determining values or prices:

- experts interviews (low reliability, mostly suited for small explorative research)
- contingent valuation method (low reliability, but no need for large databases)
- hedonic pricing analysis (high reliability, based on realized behavior, extensive data is needed)

Because of the high reliability Visser & Van Dam (2006) have chosen to use the hedonic pricing analysis in their research. Another reason to choose this method is given by Hooimeijer (2001). He links the added value of mixed use to the concept of spatial quality. Therefore, the added value is context bounded and dynamic.

Hooimeijer (2001) states that place, time, scale level, social conditions and cultural background determine how spatial quality, and therefore also mixed use, is perceived. This should be taken into account within the choice regarding the research methodology. Because of the factors stated in the above a choice for revealed preference research techniques could be preferable. These techniques are based on real consumer behavior (facts) in which the above factors are translated in the prices. This is in contrast to stated preference research techniques, where it is very difficult to include the factors mentioned above.

Regarding to possible data sets, the following options are addressed by Visser & Van Dam 2006:
- Transaction prices (‘real’ data)
- WOZ-values (low market influences, based on surroundings)
- estimates by brokers and appraisers (low market influences, mostly overestimated)

Visser & Van Dam have made the choice for transaction prices based on the NVM-databank because this data was closest to the ‘real’ practice. However the databank of the NVM is not covering the whole of the Netherlands and some segments of the housing market are underrepresented.

The most important theoretical conclusions of the research by Visser & Van Dam are that the results of their revealed preference research differs from the result of former (stated preference) research results into the value determining factors of the living environment of dwellings. Especially social and functional characteristics of the living environment seem to be important instead of the physical characteristics which showed to be important in former research. This difference is explained by Visser & Van Dam trough the tension between preferences and actual behavior, which is caused by the difference...
Appendix 1: Exploratory literature study

The broad location choice (region, city) is not taken into account within stated preference research techniques. That is why the importance of functional characteristics of the living environment are underestimated and because of this the pressure on the local dwelling markets is not taken into account within stated preference techniques.

As Visser & Van Dam focus on buildings (more specific on dwellings) this research will focus more on area level (and all types of real estate). However, the same method could be used for the research. Regarding the data of the research, the first two options (transaction prices and WOZ-values) would be most suitable. It will very much depend on the availability of data which option could be chosen.

Pros & Cons

Aim: Get insight in the advantages and disadvantages of mixed use and get a clear overview on important state of the art theories and empirical studies with regard to the of the impact of mixed use.

Disadvantages:

Dobbelenste & Wilde (2004) give the following disadvantages of mixing uses. “Multiple use of space in inner city areas is expensive. In order to enable construction on a limited building area or above infrastructure, and to minimise the negative impact of the construction process on its direct surroundings, considerably large investments are required, compared to traditional projects implying sprawl. Inner-city construction is a complex logistical process with specific environmental demands. Large investments are required to avoid noise nuisance and ensure physical safety of users and passers-by[...]. Last, but not least, there are some major complexities in the process of multiple partnerships and a lot of legal barriers concerning landownership and insurance.”

Cheah states the following about the disadvantages of mixed use: Mixed-use development often involves multiple owners whose priorities regarding design, governance, and changes in use or ownership can be in conflict both during development and after the project is complete. Reactive resolutions are time consuming, costly, and potentially fatal to the project. Because mixed-use development usually takes a long period of time for pre-development planning and construction, the possibility that the overall economic climate would change is greatly increased. The site selection is another problem of mixed-use development because large parcels of land must be assembled. In addition, mixed-use development is involved in different land use markets with its own cycles apart from the overall economy. This however could also be seen as an advantage from the point of view of risk diversification.

According to Coupland (1997), developers are rather unwilling to proceed with mixed use because they prefer safe, reliable investments which yield solid returns over an extended period instead of risky investments in mixed-use development. This is acknowledged by Louw & Bruinsma (2006) who state that developers prefer safe, reliable investments instead of risky investments in mixed-use developments.

Tomari (2006) states as main disadvantage of mixed use for builders and developers that there can be opposition amongst residents in the initiative phase of projects. According to Tomari this opposition is mainly caused by the negative reaction to higher density and uses that are not appropriate for residential areas.

All the disadvantages stated in the above can be brought back those stated in table 4.

Advantages:

The first general reason for promoting mixed-use development is to reduce the need to travel by providing for a range of requirements in close proximity. A concentration of activities makes the integration of activities possible, while at the same time providing for a combination of potential traffic flows between these concentrations based on the application of efficient traffic systems. This statement is broadly supported in relevant literature by Hoppenbrouwer & Louw (2005), Coupland (1997) and Priemus (2000). Cervero (1988) describes the transportation aspect in more detail and states that Mixed-use developments (MXD) can improve suburban mobility and reduce local traffic congestion in at least four ways: by reducing motorized travel; by spreading trips out more evenly throughout the day; by encouraging more workers to carpool; and by allowing shared-use parking arrangements to be introduced. “Besides these transportation benefits, mixed use also adds life to what sometimes are rather undistinguishable suburban work environments. By replacing vehicle trips with people trips, a far more active and socially interesting milieu can be created. A setting with an after-work night life can also entice more employees to live near their workplace, cutting down on vehicular traffic even more. A common complaint voiced by suburban businesses today is that their employees, especially those who have been reassigned from downtown, are disenchanted by the bareness and lack of urban amenities around their workplaces. For this and other reasons, mixed use appears to be becoming increasingly attractive to high-end tenants.
and are perceived by a growing number of developers as providing a competitive market advantage.” Here Cevero revers to urban diversity and vitality, which is the second general reason for promoting mixed-use development. “Mixed-use development offers opportunities to improve the quality and attractiveness of the urban area—for example by increasing use, activity and vitality during the day, in the evening and at weekends. There may also be benefits in terms of preventing crime and promoting security.” (Hoppenbrouwer and Louw, 2005)

The aspects stated in the above also stimulate and secure public realm (Jacobs, 1998)

Tomari (2006) states that mixed use can also provide opportunities in other areas than large metropolitan areas. Many smaller communities have no mixed use project at all, so the lack of competing projects could be financially lucrative.

Cheah defines several causes (advantages) of mixed use. First of all developers can gain an economic edge at the city level by taking advantage of existing infrastructures and increasing densities. Secondly, there is a market demand for it: there are more and more indications that people feel a sense of vibrancy and community when they live in a mixed-use development. Third, People living in mixed-use developments have a definite transportation advantage: it saves on time if one works near where he/she lives and has nearby access to amenities facilities.

All the advantages stated in the above can be brought back those stated in table 5.

### Table 4: main disadvantages of mixed use

<table>
<thead>
<tr>
<th>Disadvantages mixed use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased complexity</td>
</tr>
<tr>
<td>Increased costs</td>
</tr>
<tr>
<td>Increased risk</td>
</tr>
</tbody>
</table>

### Table 5: main advantages of mixed use

<table>
<thead>
<tr>
<th>Advantages mixed use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation benefits</td>
</tr>
<tr>
<td>Increased urban diversity and vitality</td>
</tr>
<tr>
<td>Synergy advantages and agglomeration effects</td>
</tr>
<tr>
<td>Increased sustainability</td>
</tr>
</tbody>
</table>

### Figure 5: Advantages of mixed use

source: Coupland (1997)
References:


Appendix 1: Exploratory literature study
Appendix 1: Exploratory literature study
Appendix 2:

In-depth Literature Study
Preface

This document contains the in-depth literature study which has been written to support the graduation thesis of the mastertrack Real Estate & Housing. This mastertrack is part of the master Architecture, Urbanism and Building Sciences at the Faculty of Architecture of the Delft University of Technology (TUD).

In this literature study several literature sources will be used to gain in-depth knowledge about certain relevant themes of the graduation research subject. Per theme a selection of relevant aspects out of the literature sources will be made. Thereafter a critical reflection based on these aspects will be made, which will lead to conclusions which can be useful our research.

In the following pages several themes will be discussed by means of selections out of relevant literature sources after which a critical reflection of the literature will be made for that specific theme.

The first theme is the research methodology. Which in this research comes down to finding the best way to measure the preference of potential end users regarding to the composition of multifunctional area developments. In this theme there will also be evaluated how the research could be set up in the most efficient way and how to get the most reliable results.

The second theme is the concrete design of the questionnaire. The possible methods regarding the design of the questionnaire will be discussed.

Breda, September 2010
Structure & Accountability of the Study

Aim: Gaining in-depth knowledge regarding preference methods which can be used in the research. Finding ways to measure the preferences of end users for different functional compositions will be the main aim of this part of the literature study.

Literature that will be used for this aim:


929 pages / 7pages per hour = 133 hours = 4,7 ECTS

Aim: Gaining in-depth knowledge regarding ways to design a solid questionnaire. Finding ways to design a proper visualisation of the choice alternatives for the questionnaire will be the main aim of this part of the literature study.

Literature that will be used for this aim:


138 pages / 7pages per hour = 20 hours = 0,7 ECTS

Literature Search : Selecting relevant literature which can be used for the aims of this literature study

Searching for literature (Google Scholar, TU Library, copus) = 7 hours

Scanning and selecting relevant literature = 13 hours

20 hours = 0,7 ECTS

TOTAL = 4,7 + 0,7 + 0,7 = 6,1 ECTS
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In this chapter is discussed which method of research could give the best reflection of the preferences of (potential) end users regarding the composition of multifunctional area developments.

1.1 | Introduction
What we want to know in this research is how (potential) end-users of real-estate objects perceive certain compositions of multifunctional area developments. In this regard concepts like acceptation and experience are important. Globally seen, these concepts can be influenced by the area development itself and the end-user characteristics. This is shown in figure 1 which is a strongly simplified representation of reality.

This research has a spatial-economic orientation and the focus will be on the influence of the functional composition of a multifunctional area development on the acceptation or experience of that area development by end users. This instead of a focus on the influence of end-user characteristics on the acceptation or experience of an area development. The latter is also of influence on the acceptation or experience of the composition of an area development but belongs more to social science related research which is not our main research field. Besides that, the intellect that determines choice behavior of a human beings is very complicated, even for advanced researchers. Because of this, the results of research with a focus on the influence of end-user characteristics on the acceptation or experience of an area development will always be relative. Therefore, the results of our research will also be relative because social and psychological effects will also have influence on the choice behavior of respondents. In this way, it could be said that every end user is unique. The same is true for a location. The uniqueness of every location and end-user should be kept in mind when interpreting the results of the research. However, the main goal is to search and explore trends or average preferences in the choice behavior of end users.

In this way there is aimed at getting insight at global preference patterns in the initiative phase of an area development. This in order to be able to develop areas with compositions that are based on market demand so that they will be occupied quickly.

Since multifunctional area developments are central in this research, there won’t be a focus on a particular kind of end user because multifunctional area developments per definition have several kinds of end-users. The interesting thing about these multiple end-users is to research if there are differences in preference and how these (possible) differences can be combined into one area. After all, an area that satisfies as much end-users as possible is the most sustainable one. It has a strong right of existence due to the support of its end-users.

1.2 | Choice out of the relevant alternatives
As mentioned before, the goal of this research is to get insight in the preferences of (potential) end users of real estate objects regarding the composition of multifunctional area developments. In order to get this insight we have to collect research data which allows us to make analysis and conclusions.

Bogerd (2009) states that there are several ways to collect research data about the appreciation of certain goods or situations. It can be done by means of “stated preference” and “revealed preference”. Revealed preference methods determine the appreciation of certain goods on the basis of behavior that has been shown. The general concept behind this method is that consumers show their appreciation by means of their acting (purchasing acts).
In this way, the preferences are always based on historical data. This could be an disadvantage for the research if state of the art information is needed. The advantage of this technique is that a lot of factors can be taken into account, therefore this technique can be seen a complete way to study the problem. However, this also leads to greater complexity. Besides that, it is hard to isolate the mixed use characteristics due to correlation with other preference determining characteristics which decreases the reliability of the research results.

Within stated preference methods a person is asked for his or her preference. Starting point is a hypothetical situation in which consumers are asked to state their preference. With this method it cannot be guaranteed that the person in question will act in the exact same way in actual practice as in the hypothetical situation. The advantage of this method is that it is suitable to research a specific subject that would be hard to isolate or separate in price-based revealed preference models. Another advantage is that there are no large data sets needed in order to conduct valid research.

A disadvantage is that it is hard to take into account the broad location factors like region and city and as already said before, there can be a difference in what consumers say that they would do and what they actually do.

Based on the aspects that will be described in the following, a choice for stated preference methods has been made.

First of all, there is the fact that a developer is in particular interested in gaining insight at preferences of potential end users in the initiative phase of projects. In this way he can translate the market demands into his plans. If a revealed preference method would be used to gain this insight, the research would be based on historical data, which can be aged or not relevant for the specific location. Therefore, revealed preference methods would be less suitable.

Secondly we want to research a quit specific subject: the influence of the functional composition of multifunctional area developments on the appreciation of the (possible) end-users. Within revealed preference methods it would be hard to isolate this specific subject due to the complexity of the method, a specific focus is therefore hard to realise. In this way, a choice for stated preference methods would be more logical because they are able to test a very specific product or subject that isn’t on the market yet. The complexity can be reduced to a more simple hypothetical situation in which a specific subject can be researched, independent of other variables.

Within stated preference methods there are two concrete methods of collecting the research data; by means of direct surveys and indirect surveys. Direct surveys are also known as the Contingent Valuation Method (CVM). In this method respondents are directly asked towards their acceptability of changes in their direct environment. For example, a person can be asked what he or she want to pay for a certain product. Respondents could make strategic choices because they think that they could profit themselves. The latter is a disadvantage of direct surveys; there could be a difference in what people say they would do and what they will do in practice.

Indirect surveys contain a short representation of a hypothetical situation which is confronted to the respondents in order to get their opinion about a certain product or situation. This method attempts to quantify qualitative information. The use of choice sets prevents strategic answers and therefore reduces the chance on social desirable answer behavior. This increases the validity of the research.

Because of the ability to quantify qualitative information and the prevention of social desirable answer behavior there has been chosen to use indirect survey methods.

Appendix 2: In-depth literature study

Revealed preferences are less suitable regarding to this aspect because they are based on historical data.

Because of the ability to quantify qualitative information and the prevention of social desirable answer behavior there has been chosen to use indirect survey methods.

In the interest of simulating the actual situation as good as possible in this research, we have chosen for discrete choice analysis in stead of conjoint analysis. Because the process of choosing between two alternatives is a better representation of actual practice than ranking or marking a certain product or situation. (Bogerd, 2009)
In the following we will discuss some of the most important advantages of indirect surveys for our research. First of all, the influence of several factors on the opinion of a person can be investigated with a relative low amount of respondents. Another advantage is that complex judgements can be reduced to a more simple situation which enables good insight into how choices are made and which factors are important regarding to that. Besides that it is also possible to get insight in the importance of individual factors in relation to each other.

Within indirect surveys there is a distinction between ‘conjoint analysis’ and ‘discrete choice analysis.’ Within Conjoint Analysis the respondent marks or ranks a certain hypothetical situation. Discrete choice analysis differ from Conjoint Analysis because there is no ranking involved, a choice is made between two or more alternatives. Breiderd (2006), quoted in Bogerd (2009), states that the process of choosing between two alternatives is a better representation of actual practice than ranking or marking a certain product or situation. Because we want to simulate the actual presence as good as possible in this research and we want to prevent personal difference in ranking, we have chosen for discrete choice analysis in stead of conjoint analysis.

An overview of the choice-path that has been made regarding to the research method can be seen in figure 2. In the following paragraph we will discuss the discrete choice method in more detail.

1.3 | Discrete choice Method
An interesting research method to investigate preferences regarding the composition of multifunctional area developments is ‘discrete choice modelling’. Discrete choice modeling experiments enable researchers to model choice in an explicit competitive context, thus realistically emulating market decisions. It is used for understanding people’s stated choice among alternatives. Within discrete choice models several attributes (area functions), which are expected to have influence on the choice behavior of respondents, are varied and presented in two sets of product alternatives (area compositions) to respondents. Bogerd (2009) states that the ideal number of attributes comes down to six (minus or plus two) attributes. This is based on the fact that respondents have limits regarding to the storage en processing of information with which they are confronted during a limited time.

A discrete choice study uses experimental design to create sets of products alternatives (area compositions), and respondents choose a product (area composition) from each set. Discrete choice studies are based on the multinomial logit model which assumes the probability that an individual will choose one of the alternatives from several choice sets. In a discrete choice study, attributes (area functions) are varied and presented within sets of product alternatives (area compositions). Respondents are asked to choose the most preferred alternative. Out of the choice between the alternatives the utility of the separate attributes (area functions) can be derived. The area function with the highest utility could be seen as the most preferred function.

1.4 | Designing and analyzing the choice sets
In order to get valid research results the design and analysis of the choice sets will be very important. The use of software to support the design and analysis processes could be useful. In the following the software program SAS will be discussed.

SAS provides several methods for analyzing marketing data which enables analysis on purchasing decision trade-offs, display product positioning, and the examination of differences in costumer behavior.
The first and latter aspects are the most interesting ones regarding to our own research. All the different types of analysis in the above can help to gain insight in products, customers and competition.

“Market research focuses on assessing the preferences and choices of consumers and potential consumers.”

(Kuhfeld, 2005 p.35)

An important step in conducting valid research is an experimental design. An experimental design is a plan for running an experiment. The factors or attributes of an experimental design are the columns or variables that have two or more fixed values, or levels. The rows of a design are called runs and correspond to product profiles. Experiments are performed to study the effects of the attribute levels on the dependent or response variable. Kuhfeld mentions full-factorial design as all possible combinations of the levels of the factors. However he states one important disadvantage of this method: “The problem with a full-factorial design is that, for most practical situations, it is too cost-prohibitive and tedious to have subjects consider all possible combinations.” For this reason, researchers often use fractional-factorial designs, which have fewer runs than full-factorial designs. The price of having fewer runs is that some effects become confounded. Effects are confounded or aliased when they are not distinguishable from each other.

The challenge of our research will be to create an as small design as possible, because of the limited time and budget, but with a good reliability. What you want is orthogonality and balance. What you need is good stability. Efficient designs can give you what you need. This is very well summed up by Mick Jagger and Keith Richards:

“You can’t always get what you want, but if you try sometimes, you just might find, you get what you need!”

(Jagger & Richards, 1969)

According to Kuhfeld (2005), an important aspect in efficient designs is choosing the right ‘design points’. These points can be seen as a minimum and maximum level which determine the scale of the research. The design points have effect on the stability of the parameter estimates. The design point should however match the research product.

Because of the possibilities that software like SAS provide, efficient choice designs can be made. The attributes can be varied among the choice sets in a very efficient way. Because of this not all of the possible combinations between the attributes and their levels have to be served to the respondents in order to get valid research results. An advantage of this is that a relative low amount of respondents is needed. As a consequence of the relative low amount of respondents it is harder to reveal the effects of personal characteristics on the research results.

When it comes to analyzing the data of discrete choice models Bogerd (2009) describes several effects. First of all there are the main effects. A main effect is the effect of a certain attribute on the total preference, without taking into account the levels of the other attributes. Secondly there are first order and higher order interactions. In higher order interactions, three or more attributes influence each other simultaneously. In first order interactions only two attributes influence each other. Interactions are possible with both attributes and external factors (like gender and age of the respondents). Out of all the observations the utility value (or use) of the attributes can be determined. The utility value represents the importance that the respondents grant to the attributes. It is based on the ‘parameter estimate’. Besides this, it is possible to look at the ‘probability of choice’ which reflects the most popular level of the attributes. This is based on a derivative of the ‘parameter estimate’.

1.5 | Conclusions

The goal of this research is to get insight in the preferences of (potential) end users of real estate objects regarding the composition of multifunctional area developments. In this chapter a evaluation has been made of the possible methods which could be used for this goal. The discrete choice method turned out to be the best option. This option provides the possibility to research a product or situation that is not on the market yet by means of an experiment. In this way there will be a creation of own (state of the art) data in stead of using existing (historical) data. Within a discrete choice experiment a choice between two product alternatives has to be made. This comes closer to the actual market situation than ranking certain products or situations. In this way a reliable prediction of the preferences of (potential) end-users regarding the functional composition of certain areas can be made.

In order to be able to collect relevant data for our research several choice sets of two product alternatives will be made which will be presented to potential end-users by means of a questionnaire. To make the most efficient design for the combination of attributes in the choice sets the computer software program SAS will be used. To prevent the research to become too complex a maximum of 8 attributes will be taken into account with a maximum of three levels.

Because of the uniqueness of every area development a choice will be made for one case study on which
the choice sets will be projected. This makes it possible to make a valid and pure comparison of the preference for several functional compositions. A disadvantage of this approach is that it is very hard to make general statements about functional compositions in relation to area developments in common. However, this is not the intention of the research. The intention is to gain insight in preferences for specific functional compositions. These preferences are location related due to the uniqueness of every location, a generalization is therefore per definition hard to make. An area-based approach would therefore be the best way to get the most accurate predictions about preferences of end-users in functional compositions.
In this chapter, methods and techniques that could help to support the design of the functional compositions are discussed. To reveal the amount of functional mix in a product alternative of the choice experiment in a clear way, several methods could be used. They will be discussed in the first paragraph of this chapter. The selection of a case study will be discussed in the second paragraph. In the third paragraph, methods for the design of the functional compositions will be discussed.

2.1 Function mix
In order to say something about the amount of functional mix in a certain area, the Herfindahl index can be used. This is a method which is often used in macro-economics, more specific in field of equal competition within business branches. It measures the concentration/market share in a specific business branch. It measures the “concentration grade” and is therefore also suitable to measure the level of mixed use within an area because it can indicate the level of functional heterogeneity (or homogeneity). For example: a monopoly in a business branch would in this case have the same index level as a monofunctional area, whereas a business branch with more players and an equal market shares would have the same index level as a area with a lot of mixed uses.

Another method is the Mixed Used Index (MXI). This method is developed by Van Hoek (2008) and measures the amount of floorspace of the different uses within an area and relates this to the total amount of floorspace in an area.

These methods could be a good way of showing the respondents at one glance how much mix the different functional compositions contain.

2.2 Case study
In order to enable a valid and pure comparison of the preferences of end users for several functional compositions we will choose one case study on which the several functional compositions will be projected. In this regard, the case study should provide enough possibility for mixed use. But how can it be judged if a certain location provides enough possibility for mixed use? This will be discussed in this paragraph.

Lau (2003) refers to critical aspects in determining the possibilities for mixed use developments, the most relevant ones are stated below:

1. Residential density and development intensity; There has to be a possibility to create a certain amount of gross floor area that makes it possible and interesting to develop several functions on one location. A certain density is needed for optimal interaction between several functions, synergy advantages could be optimized in this way. This should however fit within the environment.

2. Land use and amenities; Regulations and zoning plans should enable enough possibilities to develop several functions on a location. Besides that, the amenities and functions in the surrounding environment determine the catchment area of functions.

3. Transport modes and pedestrian links; If a location has a good accessibility, the catchment area of functions will be expanded. In this way the accessibility can determine the success of a mixed use development. These aspects can be reduced to the main characteristics of mixed use locations, which are: intense use and experience, multiple functions and supporting facilities.

The factors mentioned in the above can often be found in urban areas. In the following we will try to specify the type of urban area which has the most potential for multifunctional area developments and which is therefore the most interesting area typology regarding the case study for our research.

The most interesting area typology to use as case study is the metropolitan urban area. The metropolitan urban area is characterized by its intensive and multiple use of space in the presence of high-end public transport. The area can be reached within 1 to 3 kilometers of an intercity or regional train station. The area contains of a variety of functions.

The selected case study should match the characteristics stated in the above. The case study should be clearly presented in the questionnaire in order to give the respondents a good impression of the area typology. In this respect it is important whether the geographical location of the case study should be mentioned or not. If the geographical location is mentioned, the research will have a more regional character. The amount of potential respondents and the possibility to generalize conclusions will decrease. However a more detailed preference for the specific location could be found. If the geographical situation is not mentioned and there will be a focus on the area typology instead of the exact location, the amount of potential respondents will be bigger. Results could be generalized better for the same area typologies. In this way the relevance of the research will become higher.

2.3 Design of functional compositions
In order to be able to design several functional compositions on the selected case study certain points of departure will have to be used. The program spacemate can be used for this goal. It will be explained in the following.

In order to be able to visually design the different functional compositions some departure points will be needed. In this regard the proper ratios in relation
to the chosen type of location will be important. The program spacemate can help to determine these ratios.

The application helps to find important aspects (like density and urbanization) related to the type of location. It is a fine instrument for making the translation from the quantitative aspects of mixed use into the qualitative aspects, which will be needed for the visualization of the choice sets in the questionnaire.

“It clearly sets out the linkage between densities on the one hand and land development, urbanization and non-built space on the other.” (Permeta Architects)

When it comes to measuring urban typologies Berghauser Pont & Haupt (2005) provide the aspects stated in the following:

1. FSI (Floor space index)
   To obtain this index the total GFA (Gross Floor Area) is divided by the PA (Plan Area), see figure 4. The FSI expresses the **built intensity** of an area.

2. GSI (Ground space index)
   In order to obtain this index, the BA (Built Area) is divided by the PA, see figure 5. The GSI expresses the **compactness** of an area.

3. OSR (Open space Ratio)
   The OSR is obtained by dividing the PA minus the BA by the GFA, see figure 6. The OSR expresses the **openness** of an area and the **pressure on the non-built space**.

4. L (Layer)
   In order to obtain the amount of layers, the GFA is divided by BA, see figure 7.

   L expresses the average number of floors in an area.

   The aspects stated before can serve as departure points for designing the functional compositions. Spacemate is able to attach reference images to certain combinations of the ratios/indexes stated in the above. In this way a design framework can be made which matches the locationtype. Within this design framework there can be varied between several functional compositions.

   If the ratios for the selected area typology are determined, a total development program can be designed. The starting point will be the total amount of m2 GFA that is possible, based on the average ratios for the selected area typology. When the amount of possible GFA is know, we want to know how this amount should be divided amongst the several possible area functions in order to create a program that has the highest market potential. Ultimately, we would like to know the direct opinion of end users regarding to this aspect. However, for the sake of the structure and possibilities for analysis of the research we will have to make some demarcations. These demarcations are described in the following.

   What we want is to test different functional compositions which are possible within design framework of the selected location. Because not all of the possible functional compositions can be tested, a demarcation will be made into three levels per function. The first level of the area functions will be a main function, the second level will be a secondary function and the third level will be no presence at all. This will be applied to all the selected area functions except for public space, this function will have only two levels: accent or functional.

   The departure point will be an area with a (mathematical) perfectly balanced function mix. With five area functions this will come down to an equal market share of each function, which is twenty percent. This market share will

Appendix 2: In-depth literature study
be based on the design framework for the selected location. Within the design framework we will have to define a maximum and minimum amount of square meters GFA that is possible within the selected area. The level main function will be twenty percent of the maximum amount of square meters GFA from the design framework whereas the level secondary function will be twenty percent of the minimum amount of square meters GFA of the design framework. This will have to be done in order to prevent that the option in which will be chosen for all the area functions as main function will not be realizable within the selected area.

The working method stated before is based on the principle of an equal division of functions but allows the respondents to choose different levels of presence per function. Therefore multiple divisions of functions are possible next to an equal division of functions but the possibilities are however limited by the design framework so that it will be realistic options for the location type.

2.4 Conclusions
In this chapter we have discussed possible ways to design the product alternatives (or choice options) of the questionnaire that will be part of this research. First of all it is important to reflect the amount of functions in the area in a clear way to respondents. Besides images, this can be done by means of a ratio or index, like the Herfindahl or Mixed Use index.

To get a pure and valid insight of the preferences for different functional compositions, there will be chosen for one case study on which several functional compositions will be projected. This will be done because of the fact that preferences can differ per area typology. Because of the focus of this research we want to exclude the difference in preference caused by different area typologies as much as possible. Therefore there has been chosen for one area typology, which provides the most potential for multifunctional area developments: the metropolitan urban area.

In order to design different functional compositions on the selected case study, some demarcations and departure points are needed. Based on the average characteristics (density/urbanization) of the area typology metropolitan urban area, a design framework will be made which will determine the amount of GFA per level of a function (main function, secondary function, no presence). In this way choice options are designed which will match the area characteristics.
Literature list


Appendix 3:

Choice Design
Designing choice experiment: size selection candidate design
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* - 100% Efficient design can be made with the MktEx macro.
S - Saturated Design - The smallest design that can be made.
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Appendix 3: Choice Design
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Appendix 4: Questionnaire
# 1 General

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<td><strong>Questionnaire</strong></td>
<td>Enquete Joost Roks: Multifunctionele stationsgebieden</td>
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<td><strong>Status</strong></td>
<td>Published</td>
</tr>
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</tr>
<tr>
<td><strong>Remaining time</strong></td>
<td>30 day(s), 7 hour(s), 58 minute(s)</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>46 questions in 11 sections</td>
</tr>
<tr>
<td><strong>Language setting</strong></td>
<td>Nederlands</td>
</tr>
</tbody>
</table>

## General statistics

| **Number contacted**  | 534                           |
| **Number started**    | 406 (76%)                     |
| **Number completed**  | 178 (33% total, 44% started)  |
| **Average time taken**| 00:12:40 ± 00:14:04 (111%)    |
| **Average time span** | 01:35:04 ± 09:05:41 (574%)    |
| **Average number of sessions** | 1.1 ± 0.3 (24.8%) |
Welkom!

Deze enquête maakt deel uit van een afstudeeronderzoek vanuit de opleiding Real Estate & Housing aan faculteit bouwkunde van de TU Delft.

Wat moet ik doen?
Volg de instructies op uw scherm en maak een keuze wanneer dat wordt gevraagd.

Hoe werkt het?
Gebruik de knoppen verder en terug (onder aan de pagina) om door de enquête heen te gaan. Deze enquête is geoptimaliseerd voor breedbeeld schermen. Mocht uw schermresolutie anders zijn ingesteld gebruik dan de toetsencombinatie ctrl+ of ctrl- om in of uit te zoomen.

Hoeveel tijd kost mij dit?
De totale enquête zal ongeveer 10 minuten duren.

Wat kan ik winnen?
Door deze enquête in te vullen maakt u kans op een van de SENZ STORM PARAPLUS'S die worden verloot onder de deelnemers!

Alvast dank voor uw medewerking!

Deze enquête is geoptimaliseerd voor Windows Internet Explorer, gebruikt u standaard een ander browser kopieer dan de volgende link in Windows Internet Explorer:
http://enquête.tudelft.nl/site/c-3350314441-1438-4-0-5-5-2615556-65-96-35916

Afstudeeronderzoek Joost Roks: de compositie van multifunctionele stationsgebieden
Op de volgende pagina zal een film worden getoond:

- De film beschrijft een omgeving van een intercity station in Nederland.

- Kijk goed naar deze film, in het vervolg van deze enquête worden er vragen gesteld over de omschreven situatie.

- De film toont tevens een omschrijving van wat van u wordt verwacht.
Hoe zou u zich omschrijven in relatie tot de zojuist getoonde locatie? (maak uw keuze onderaan)

**Als bewoner:**
Ik zou op deze locatie willen wonen

**Als organisatie:**
Ik zou de huisvesting van mijn onderneming op de locatie willen onderbrengen

**Als bezoeker:**
Ik zou voor activiteiten anders dan wonen en werken naar het gebied willen komen (bijvoorbeeld winkelen)

**Als belegger:**
Ik zou in gebouwen op deze locatie willen beleggen

Als bewoner • Als organisatie • Als bezoeker • Als belegger

Toep Verder

Afstudeeronderzoek Joost Roks: de compositie van multifunctionele stationsgebieden

Appendix 4: Questionnaire
**Om een indruk te krijgen van uw organisatie worden een aantal achtergrondvragen aan u gesteld:**

**In welke provincie is uw organisatie momenteel gehuisvest?**
- [ ]省份

**Waar is uw organisatie vooral actief?**
- [ ] lokaal
- [ ] regionaal
- [ ] nationaal
- [ ] internationaal

**Hoeveel personeelsleden telt uw organisatie?**
- [ ] < 20
- [ ] 20-40
- [ ] 41-60
- [ ] 61-80
- [ ] 81-100
- [ ] > 100

**In welke sector is uw organisatie actief?**
- [ ] zekelja dienbedening
- [ ] financieele instellingen
- [ ] handel & horeca
- [ ] industrie
- [ ] bouw
- [ ] kwartaire sector
- [ ] overige

---

*Afstudeeronderzoek Joost Roks: de compositie van multifunctionele stationsgebieden*
In het volgende onderdeel maakt u telkens een keuze uit twee mogelijkheden, deze mogelijkheden vormen samen een keuzeset.

- De keuzesets bestaan uit twee verschillende indelingen van het gebied rondom het intercity station. U dient hieruit uw favoriete indeling te kiezen.

- Let bij uw keuze vooral op de aanwezigheid (hoeveelheid) van de functies. De aanwezigheid van de functies in het gebied varieert namelijk per keuze mogelijkheid. De uiterlijke kenmerken en plaatsing van de gebouwen zijn van minder belang.

- Bepaalde gebiedsindelingen kunnen in meerdere keuzesets voorkomen. Het gaat echter om de individuele afweging van de twee mogelijkheden ten opzichte van elkaar in een keuzeset.
Welke afbeelding heeft uw voorkeur?

**Afbeelding 1:**
- Evenrode verdeling: alle functies in gelijke hoeveelheid aanwezig

**Afbeelding 2:**
- Hoofdfunctie: maatschappelijke voorzieningen
  - Afwezig = winkels

<table>
<thead>
<tr>
<th>Functie</th>
<th>Aanwezigheid</th>
</tr>
</thead>
<tbody>
<tr>
<td>= woningen</td>
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<tr>
<td>= kantoren</td>
<td>20%</td>
</tr>
<tr>
<td>= winkels</td>
<td>20%</td>
</tr>
<tr>
<td>= commerciële vrijtijdsvoorzieningen</td>
<td>20%</td>
</tr>
<tr>
<td>= maatschappelijke voorzieningen</td>
<td>20%</td>
</tr>
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**Afbeelding 2**

<table>
<thead>
<tr>
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</thead>
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<td>= winkels</td>
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<tr>
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<td>20%</td>
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<tr>
<td>= maatschappelijke voorzieningen</td>
<td>40%</td>
</tr>
</tbody>
</table>
Welke afbeelding heeft uw voorkeur?

**Afbeelding 1:** Hoofdfunctie = winkels afwezig = woningen

- Woningen: 0%
- Kantoren: 20%
- Winkels: 40%
- Commerciële vrijetijdsvoorzieningen: 20%
- Maatschappelijke voorzieningen: 20%

**Afbeelding 2:** Evenredige verdeling: alle functies in gelijke hoeveelheid aanwezig

- Woningen: 20%
- Kantoren: 20%
- Winkels: 20%
- Commerciële vrijetijdsvoorzieningen: 20%
- Maatschappelijke voorzieningen: 20%
Welke afbeelding heeft uw voorkeur?

**Afbeelding 1:** hoofdfunctie = maatschappelijke voorzieningen
afwezig = kantoren

- Woningen: 20%
- Kantoren: 0%
- Winkels: 20%
- Commerciële voorzieningen: 20%
- Maatschappelijke voorzieningen: 40%

**Afbeelding 2:** evenredige verdeling: alle functies in gelijke hoeveelheid aanwezig

- Woningen: 20%
- Kantoren: 20%
- Winkels: 20%
- Commerciële voorzieningen: 20%
- Maatschappelijke voorzieningen: 20%
Welke afbeelding heeft uw voorkeur?

Afbeelding 1: hoofdfunctie = kantoren, afwezig = winkels

**Functie:**
- woningen: 20%
- kantoren: 40%
- winkels: 0%
- commerciële vrijetijdsvoorzieningen: 20%
- maatschappelijke voorzieningen: 20%

Afbeelding 2: hoofdfunctie = winkels, afwezig = kantoren

**Functie:**
- woningen: 20%
- kantoren: 0%
- winkels: 40%
- commerciële vrijetijdsvoorzieningen: 20%
- maatschappelijke voorzieningen: 20%
Welke afbeelding heeft uw voorkeur?

**Afbeelding 1:** evenredige verdeling: alle functies in gelijke hoeveelheid aanwezig

**Afbeelding 2:** hoofdfunctie = woningen, afwezig = commerciële vrijetijdsvoorzieningen

### Functie:
- woningen 20%
- kantoren 20%
- winkels 20%
- commerciële vrijetijdsvoorzieningen 20%
- maatschappelijke voorzieningen 20%

### Functie:
- woningen 40%
- kantoren 20%
- winkels 20%
- commerciële vrijetijdsvoorzieningen 0%
- maatschappelijke voorzieningen 20%
In het onderstaande wordt u gevraagd om zelf uw optimale plaatsing van functies samen te stellen. Dit kunt u doen door per functie aan te geven in welk gebied (1,2,3,4 of 5) uit de onderstaande afbeelding u deze functie het liefst ziet.

Let op: u kunt elk gebied maar 1 keer kiezen! U dient aan elke functie een gebied toe te kennen!
In het onderstaande dient u zelf uw optimale indeling samen te stellen. Dit kan middels de schuifbalk. U kunt hiermee zelf de aanwezigheid per functie (in percentage) bepalen. U kunt alleen keuzes maken per 10 tal procenten.

*Let op: het totaal (5 functies) moet gelijk zijn aan 100%!*

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>Kantoren (%)</td>
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<td>10</td>
</tr>
<tr>
<td>Winkels (%)</td>
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<td>10</td>
</tr>
<tr>
<td>Commerciële vrijtijdsvoorzieningen (%)</td>
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<td>10</td>
</tr>
<tr>
<td>Maatschappelijke voorzieningen (%)</td>
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<td>10</td>
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</table>

*Afstudeeronderzoek Joost Roks: de compositie van multifunctionele stationsgebieden*
Einde van deze enquête

Dank voor uw medewerking!

Bent u benieuwd naar de resultaten van dit onderzoek of heeft u vragen of opmerkingen? Meld dan naar: j.a.o.roks@student.tudelft.nl
Appendix 5:

Analysis Research Population
Residents, N=21 (12%):

Gender:
- Man: 66%
- Vrouw: 34%

Education:
- Lager beroepsonderwijs, VMBO: 28%
- Mavo, Mulo, VMBO-T: 5%
- Middelbaar beroepsonderwijs: 9%
- Havo: 5%
- HBS, Atheneum, Gymnasium, VWO: 9%

Income:
- Minder dan 20.000 euro: 35%
- 20.000 euro tot 30.000 euro: 16%
- 30.000 euro tot 40.000 euro: 16%
- 40.000 euro tot 50.000 euro: 15%
- Meer dan 50.000 euro: 10%

Age:
- <20: 7%
- 20-40: 1%
- 41-60: 37%
- 61-80: 55%

Family situation:
- Alleenstaand: 35%
- Relatie, apart wonend: 21%
- Samenwonen / Getrouwd: 10%
- Samenwonen / Getrouwd; met kinderen: 13%

Province:
- Gelderland: 16%
- Noord-Brabant: 4%
- Noord-Holland: 4%
- Utrecht: 2%
- Overijssel: 13%
- Limburg: 3%
- Zeeland: 3%
- Zuid-Holland: 71%

Appendix 5: Analysis research population
Organizations, N=34 (19%):

Provinces:
- Flevoland: 70%
- Gelderland: 15%
- Noord-Brabant: 6%
- Overijssel: 3%
- Utrecht: 3%
- Zuid-Holland: 2%

Organization size (FTE):
- < 20: 32%
- 20-40: 38%
- 41-60: 21%
- 81-100: 3%
- > 100: 3%

Business Orientation:
- Lokaal: 35%
- Regionaal: 9%
- Nationaal: 15%
- Internationaal: 41%

Business Sector:
- Zakelijke dienstverlening: 28%
- Industrie: 15%
- Kwartaal sector: 15%
- Financiële instellingen: 15%
- Bouw: 4%
- Overige: 3%
Appendix 5: Analysis research population
Investors, N=16 (9%):

Investor type:
- Particulier: 75%
- Institutioneel: 25%

Activity:
- Lokaal: 31%
- Regionaal: 38%
- Nationaal: 12%
- Internationaal: 19%

Average invested capital: 756,500,000 euro
Appendix 6: Probability of Choice of the area compositions
In the above, the probability of choice for each unique area composition is given. Based on the total range of choice probabilities, a raking from very good to very bad is made.
Appendix 7: Analysis of the Choice Probabilities
Appendix 7: Analysis of the choice probabilities
Office function

Appendix 7: Analysis of the choice probabilities
Appendix 7: Analysis of the choice probabilities
Appendix 7: Analysis of the choice probabilities
Appendix 7: Analysis of the choice probabilities
Appendix 8:

Residual Land Values
<table>
<thead>
<tr>
<th> </th>
<th>Gross Initial Yield %</th>
<th>Rent per m2 GFA</th>
<th>Price per m2</th>
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<tbody>
<tr>
<td>Residential</td>
<td>5,00%</td>
<td>143</td>
<td>2.850</td>
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<tr>
<td>Office</td>
<td>7,25%</td>
<td>160</td>
<td>2.207</td>
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<tr>
<td>Retail</td>
<td>6,75%</td>
<td>175</td>
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<td>Leisure</td>
<td>8,00%</td>
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<td>Amenities</td>
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<table>
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<tr>
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<th>Building Costs per m2</th>
<th>% of total development costs</th>
<th>Total development costs per m2</th>
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<tr>
<td>Residential</td>
<td>€ 1.200</td>
<td>65</td>
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<td>€ 1.300</td>
<td>65</td>
<td>€ 2.000</td>
</tr>
<tr>
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<td>€ 1.000</td>
<td>65</td>
<td>€ 1.538</td>
</tr>
<tr>
<td>Leisure</td>
<td>€ 1.500</td>
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<td>Amenities</td>
<td>€ 1.500</td>
<td>65</td>
<td>€ 2.308</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th> </th>
<th>Residual value per m2</th>
</tr>
</thead>
<tbody>
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</tr>
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<td>Office</td>
<td>€ 207</td>
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<tr>
<td>Retail</td>
<td>€ 1.054</td>
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<tr>
<td>Leisure</td>
<td>-€ 433</td>
</tr>
<tr>
<td>Amenities</td>
<td>-€ 308</td>
</tr>
</tbody>
</table>

- Gross Initial Yields are rents based on figures of DTZ, Jones Lang LaSalle, CBRE and the experience of the graduation company.
- Rent prices are based on figures of DTZ, Jones Lang Lang LaSalle, CBRE, Horwath and the experience of the graduation company.
- Building costs are based on www.bouwkosten-online.nl (februari 2011)
<table>
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<th>Leisure</th>
<th>Amenities</th>
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<td>20%</td>
<td>40%</td>
<td>0%</td>
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<td>100%</td>
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<td>47.000</td>
<td>47.000</td>
<td>94.000</td>
<td>0</td>
<td>47.000</td>
<td>235.000</td>
</tr>
<tr>
<td>residual value</td>
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<td>€ 9.724.138</td>
<td>€ 99.088.319</td>
<td>€ 0</td>
<td>-€ 14.461.538</td>
<td>€ 141.531.688</td>
</tr>
</tbody>
</table>

| percentage  | 40%         | 20%    | 20%    | 0%      | 20%       | 100%   |
| square meters | 94.000     | 47.000 | 47.000 | 0       | 47.000    | 235.000 |

| percentage  | 20%         | 20%    | 40%    | 20%     | 0%        | 100%   |
| square meters | 47.000     | 47.000 | 94.000 | 47.000  | 0         | 235.000 |
| residual value | € 47.180.769 | € 9.724.138 | € 99.088.319 | -€ 20.336.538 | € 0 | € 135.656.688 |

| percentage  | 20%         | 0%     | 40%    | 20%     | 20%       | 100%   |
| square meters | 47.000     | 0      | 94.000 | 47.000  | 47.000    | 235.000 |
| residual value | € 47.180.769 | € 0 | € 99.088.319 | -€ 20.336.538 | -€ 14.461.538 | € 111.471.011 |

| percentage  | 40%         | 0%     | 20%    | 20%     | 20%       | 100%   |
| square meters | 94.000     | 0      | 47.000 | 47.000  | 47.000    | 235.000 |

| percentage  | 20%         | 40%    | 20%    | 0%      | 20%       | 100%   |
| square meters | 47.000     | 94.000 | 47.000 | 0       | 47.000    | 235.000 |
| residual value | € 47.180.769 | € 19.448.276 | € 49.544.160 | € 0 | -€ 14.461.538 | € 101.711.666 |

| percentage  | 0%          | 20%    | 40%    | 20%     | 20%       | 100%   |
| square meters | 0         | 47.000 | 94.000 | 47.000  | 47.000    | 235.000 |

| percentage  | 20%         | 20%    | 20%    | 20%     | 20%       | 100%   |
| square meters | 47.000     | 47.000 | 47.000 | 47.000  | 47.000    | 235.000 |

| percentage  | 40%         | 20%    | 0%     | 20%     | 20%       | 100%   |
| square meters | 94.000     | 47.000 | 0      | 47.000  | 47.000    | 235.000 |

Appendix 8: Residual land values
<table>
<thead>
<tr>
<th>Percentage</th>
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<th>20%</th>
<th>20%</th>
<th>20%</th>
<th>40%</th>
<th>100%</th>
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</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 47,180.769</td>
<td>€ 49,544.160</td>
<td>€ 20,336.538</td>
<td>€ 28,923.077</td>
<td>€ 47,465.313</td>
<td></td>
</tr>
<tr>
<td>Residual Value</td>
<td>€ 0</td>
<td>€ 0</td>
<td>€ 20,336.538</td>
<td>€ 28,923.077</td>
<td>€ 47,465.313</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>20%</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>20%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 47,000</td>
<td>€ 47,000</td>
<td>€ 94,000</td>
<td>€ 47,000</td>
<td>€ 235,000</td>
<td></td>
</tr>
<tr>
<td>Residual Value</td>
<td>€ 0</td>
<td>€ 49,544.160</td>
<td>€ 14,461.538</td>
<td>€ 41,590.313</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
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<th>20%</th>
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<th>20%</th>
<th>100%</th>
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</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 0</td>
<td>€ 19,448.276</td>
<td>€ 49,544.160</td>
<td>€ 41,590.313</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Value</td>
<td>€ 0</td>
<td>€ 0</td>
<td>€ 40,673.077</td>
<td>€ 34,194.358</td>
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</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>20%</th>
<th>40%</th>
<th>0%</th>
<th>20%</th>
<th>20%</th>
<th>100%</th>
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</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 47,000</td>
<td>€ 94,000</td>
<td>€ 47,000</td>
<td>€ 47,000</td>
<td>€ 235,000</td>
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<th>20%</th>
<th>40%</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 47,000</td>
<td>€ 47,000</td>
<td>€ 0</td>
<td>€ 47,000</td>
<td>€ 235,000</td>
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<td>Residual Value</td>
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<td>€ 20,336.538</td>
<td>€ 31,830.968</td>
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<table>
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<th>20%</th>
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<th>40%</th>
<th>20%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square Meters</td>
<td>€ 0</td>
<td>€ 47,000</td>
<td>€ 47,000</td>
<td>€ 94,000</td>
<td>€ 235,000</td>
<td></td>
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<tr>
<td>Residual Value</td>
<td>€ 9,724.138</td>
<td>€ 49,544.160</td>
<td>€ 40,673.077</td>
<td>€ 41,590.313</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Very Good | € 141,531.688 | € 114,052.087 |
| Good | € 114,052.087 | € 86,572.486 |
| Average | € 86,572.486 | € 59,092.884 |
| Bad | € 59,092.884 | € 31,613.283 |
| Very Bad | € 31,613.283 | € 4,133,682 |

On the basis of the key figures, a residual value per function per m² is calculated. These m² values per functions are attached to the different area compositions, which has resulted in a residual value of the total compositions. Based on this, the ranking based on added value has been defined in the above.