

TENANT PARTICIPATION IN SUSTAINABLE RENOVATION PROJECTS

The influence of project content on the tenant participation of sustainable renovation projects within housing associations, using AHP and case study.

Author

S. (Susan) Reuvekamp

Graduation program

Construction Management and Urban Development
Eindhoven University of Technology

Graduation committee

Prof. dr. ir. Wim Schaefer (TU/e)

Dr. ir. Brano Glumac (TU/e)

Linda Groenen MSc. (Atriensis)

Eindhoven, August 28th 2013



Table of Contents

1	Introduction.....	7
1.1	Social housing types	7
1.2	Association-tenant interdependence.....	8
1.3	Energy related directives.....	8
1.4	Importance of taking action	9
1.5	Sustainable renovation.....	10
1.5.1	Problems.....	11
1.5.2	Tenant participation as problem focus	11
1.6	Atriensis	12
2	Research plan	13
2.1	Problem statement.....	13
2.2	Research questions	13
2.3	Research design.....	13
2.4	Relevance	14
2.5	Reader manual	15
3	Project decisions.....	17
3.1	Technical decisions.....	17
3.2	Financial decisions.....	18
3.2.1	Percentage expected saving.....	19
3.2.2	Percentage investment	19
3.2.3	Amount per label step.....	20
3.2.4	Inconvenience fee	20
3.3	Tenant approach	21
3.3.1	Communication	21
3.3.2	Tenants say.....	21
3.4	Execution decisions	23
3.5	Conclusion	23
4	Tenant participation	25
4.1	Tenant dependent factors.....	25
4.1.1	Tenant characteristics	25
4.1.2	Resistance.....	27
4.2	Tenants needs	28
4.2.1	Understanding.....	28

4.2.2	Benefit	28
4.2.3	Nuisance limitation.....	28
4.3	Project dependent factors.....	29
4.3.1	Strategic asset management.....	29
4.3.2	Responsibility	29
4.4	Project content.....	30
4.4.1	Technical decisions.....	30
4.4.2	Financial decisions.....	30
4.4.3	Tenant approach	31
4.4.4	Execution plan	31
4.5	Preliminary statement.....	31
4.6	Conclusion	33
5	The Analytic Hierarchy Process	35
5.1	Application of AHP.....	35
5.2	Principles of the method	36
5.2.1	Hierarchy model	36
5.2.2	Pair-wise comparisons.....	37
5.2.3	Pair-wise matrix evaluation.....	37
5.2.4	Consistency analysis	39
5.2.5	Choosing the best alternative	41
5.3	Data implementation	41
5.3.1	Hierarchy model.....	41
5.3.2	Respondent characteristics	43
5.3.3	Survey design.....	43
5.3.4	Data quality	44
5.3.5	Main results.....	44
5.3.6	Group results	46
5.4	Conclusion	52
6	The case alternatives.....	53
6.1	Determination of the weights	53
6.1.1	Numerical output	54
6.1.2	Descriptive output.....	55
6.2	Rating the cases.....	55
6.3	Case application	56

6.3.1	Weights of the cases	56
6.3.2	Scores	59
6.3.3	Sensitivity analysis	60
6.4	Conclusion	62
7	Conclusions and recommendations	63
7.1	Most striking results and conclusions	63
7.1.1	Differences between the literature and the survey	63
7.1.2	Willingness of the tenants	65
7.1.3	Project managers disunity	65
7.2	Recommendations	65
7.2.1	Understand, want, be able	65
7.2.2	Checklist	66
7.3	Discussion	67
7.4	Further research	68
	References	69
	Appendices	73
	Summaries	85

1 Introduction

The Dutch social housing market is unique when it comes to social rentals. About one third of the houses in the Netherlands is social rent and is operated by housing associations. From a tradition which goes back over a century, housing associations play a crucial role in the housing for the target group with a low income. In the Netherlands there are approximately 430 housing associations with a total of 2.4 million rentals. The number of social rentals is reasonably stable the recent years and the number of housing associations is steadily decreasing due to merging (Atriensis, 2012).

As a result of neoliberal policies, the housing associations have gained considerable administrative and financial independence in the 1990s. Due to the financial independence, the associations had to think about policy with respect to their asset management. Until then, housing associations were government owned and only responsible for the maintenance of the dwellings, and the government for the policies. Also, since 1995 the subsidy requirement of the government is eliminated to the redemption obligation of the association. The only thing left was the value of the real estate, thus the dwellings were not only a user property, but also capital property (Nauwelaerts de Agé, 2010).

Despite the independence, housing associations still have the social purpose to provide affordable rental dwellings for people with a low income. Being independent with a social purpose puts housing associations in an interesting position between the government, market and community.

1.1 Social housing types

Although housing associations were introduced at the beginning of the 20th century, most social dwellings nowadays are built after World War II because of the enormous demand for dwellings during the reconstruction period. From 1945 to 1975, the social rental sector mostly developed terraced single-family dwellings. Before the energy crisis in 1973, these houses were typical dwellings with two floors, four rooms and a sloping roof, with the space beneath the roof being not being used before 1960. Since 1960, the use of a cavity wall between dwellings became mandatory. During this time, an owner-occupied dwelling was less obvious for most people and over 50% of the dwellings in the 60s were social housing (Den Otter, 2009).

Until 1970, the attic could be used but was only accessible by a stepladder. All dwellings were built with single glazed windows and moderately to poorly insulated walls, floors and roofs and a presence of many thermal bridges. Since 1970, the industrial construction wave decreases and the use of wall insulation become more common. Also, all newly constructed dwellings are automatically connected to the central heating, resulting in more comfort, but also a higher energy bill. Because these dwellings were built low-budget and within a short construction time, they can be defined as minimalistic and effectively built. The floor map is designed as small as possible and the energy label of these dwellings are usually E, F or G (Straub et.al, 2002).

Due to the rising prosperity from the mid 80s, the qualitative housing demands have increased and a large part of the original target group (middle class families) has moved to bigger single-family dwellings in newer neighborhoods. Nowadays, those who could not make that step, or did not find it necessary to move are nowadays elderly people. The

outflow if middle class families gave room for a new generation of social housing tenants. Nowadays, parts of the inflow are ethnic minorities (mostly large families) and young starters (single or double earners without children) (Werf, 2011).

1.2 Association-tenant interdependence

According to rules on state aid from the European Committee, an association can practically be seen as two entities. One entity can build rental dwellings up to the limit of € 681.02 monthly rent (in 2013) and at least 90% of these dwellings should be allocated to households with an income below € 34,229 (price level 2013). Herewith, this entity provides a service of public economic interest (Dutch: Dienst Algemeen Economisch Belang, DAEB) and the tenants of these houses can claim housing grant (Dutch: huurtoeslag). The other entity may build more expensive rentals and dwellings for sale. Although the second entity is allowed to rent and sell dwellings at profitable prices, the main goal of these activities is to compensate the costs for the first, non-commercial entity. So primarily, housing associations have a social function. However, they are unique among social organizations because of their owning of real estate and capital.

The social function of a housing association is defined in the Management Directive Social Rent Sector (Dutch: Besluit Beheer Sociale Huursector; BBSH). This directive describes six basic performances which should be met in the business operations of the association (Aedes, 2012):

1. Maintaining the quality of their housing stock
2. The rentability of this housing stock and the housing of the primary target group
3. Involving tenants in policy making and management
4. Taking care of livability in neighborhoods within the housing associations' area of operation
5. Combining and optimizing housing and care

Besides the BBSH there is also the Consultation Law (Dutch: Overlegwet). Due to this law, the property owner is obliged to inform the tenants about changes in the rental policy. This informing is often expressed via a letter to the tenants in which the project is mentioned.

The interdependence between the association and the tenants is in the first place reflected by the fact that tenants of social housing do not have the possibility to easily move or buy a house. They are dependent on the low rent and the housing benefit from the government. On the other hand, the association is obliged to maintain the quality and rentability and involving the tenants in their policy making.

1.3 Energy related directives

As a response to worldwide environmental issues, a new subject has become increasingly important for the built environment: energy. Within the European Union the energy use by the built environment is over 40% of the total energy consumption and 30% of the total CO₂ emission (EnergyCounsil, 2002). A large part of this CO₂ emission and energy consumption can be attributed to household energy use (Guerra Santin et.al, 2009). To reduce the CO₂ emission of the build environment, the European Union has created a directive for existing and new buildings as stimulation mean: the Energy Performance of Building Directive (EPBD). The intention of this directive is:

“...to stimulate improvements of the energy performance of buildings within the community, taking into account both climatic and local conditions outside the building and the indoor climate requirements -, and the cost-effectiveness.” (European Parliament and the European Council, 2002)

For the built environment, the directive of the EPDB has several consequences. The development of a method to calculate the integrated energy performance of a building, the determination of minimum requirements for the energy performance, the introduction of a system to certify energy performance and the regular maintenance of heating boilers and air-conditioning systems are mandatory actions derived from the EPBD (Dalen et.al, 2007).

In 2008, the Dutch government responded to the energy topic and the EPBD by making it obligatory for Dutch dwelling owners to have an energy label for their dwelling. An energy label shows the energy performance of the dwelling and can only be determined by an authorized certified advisor. The label of a dwelling can vary from A: 44 points and thus highly energy efficient to G: 0 points and thus not energy efficient. The points are based on several characteristics of the dwelling that influence the energy efficiency. For example the size, window surface, materials and installations. An energy label is made obligatory to stimulate energy reducing measures and as being house owners, the associations were forced to invest in the labelling of their stock.

As additional action, the Ministry of Spatial Planning and Environment (Dutch: Volkshuisvesting, Ruimtelijke Ordening en Milieu) in collaboration with Aedes¹ and the Dutch Woonbond² have created a covenant specifically for the Dutch housing associations. This covenant includes agreements on goals on energy saving improvements (Ministry of Internal Affairs, 2012). Within this covenant is mentioned that an average energy label B for the stock of a housing associations is the target in 2020. These ambitions are high and ask for solutions for the whole building stock of housing associations. As a result, the associations should think about the application of sustainable energy within their housing stock, define their own goals and implement these goals into their policies.

1.4 Importance of taking action

Over the past years, the Dutch market in new built dwellings has nearly ground to a halt. With a new built rate of less than 1% (CBS, 2011) which means that in a year less than 1% of the existing stock is new built, the focus is no longer on the new buildings but on the existing building stock. It is important to invest in the energy efficiency of the existing stock due to several reasons.

First, the consequence of the possible increasing energy prices for the existing housing stock is important. Different organizations have made a forecast of these increasing costs. WijksteunpuntWonen (2011) expects an increase of the gas price with 7-10% a year and an increase of basic rent of 3.1% a year. After 2016, the energy costs can be higher than the basic rent. Also DeltaWonen (2010) has expressed an opinion about the increasing integrated housing costs³. The expected integrated housing costs show a dramatic increase of the housing costs quote⁴ the coming years for a family that rents a house with a low

¹ Sector organization which represents Dutch housing associations

² Organizations which represents the interests of tenants and rental home seekers

³ Integrated housing costs are the basic rent plus the energy costs and service costs

⁴ The housing costs quote is the sum of the energy costs divided by the disposable income

energy label. This quote could mount up from over 20% up to around 70% in the coming 25 year (DeltaWonen, 2010).

The second aspect is the environmental impact, and is expressed in the goals of the covenant. As mentioned in section 1.1, the built environment is responsible for over 40% of the total energy consumption and 30% of the total CO₂ emission. Looking at the energy performance, over 55% of the social rentals have an energy label D or less which are dwellings with a poor energy performance. This means that about 1.6 million dwellings have a poor energy performance (SenterNovem, 2012). Investing in the energy efficiency of these dwellings has a positive influence on the environmental impact of the built environment.

The last aspect is that for housing associations, it is important to guarantee the value of their stock. Since 2011, energy performance is included in the Property Value System⁵ (PVS), the energy performance is part of the property valuation, and is therefore reflected in the rent. In order to maintain the market value of their stock, it is important for housing associations to keep investing in the energy performance also.

1.5 Sustainable renovation

As a response to the stimulation to improve the energy performance of their dwellings, housing associations perform sustainable renovation. In this research sustainable renovation is defined as:

“A renovation to transform an existing building to fulfil the requirements on the field of the energetic performance and the health and comfort of its users while achieving economic viability”

With sustainable renovation, housing associations are able to increase the energy performance of their dwellings. This leads not only to an increasing stock value, but also has the aim to increase the living comfort of the tenants and a decrease of the energy costs. It is important here to mention the difference between renovation and maintenance. Renovation increases the value and economic lifetime of a complex, while maintenance is intended to guarantee the utility and a proper performance of the complex during the economic lifetime (Borst, 2006). This means that a renovation has an influence on the value of the dwelling and the costs can be passed on to the tenants, for example by rent increase. Maintenance does not have an impact on the dwelling value or the rent, but maintains the condition of the dwelling. Permission of the tenants for the work is therefore crucial in renovation projects, while this is not necessary when the work falls under maintenance. When a housing association wants to perform a renovation, it is stated by law that 70% of the tenants which have to deal with the renovation on which the project has an effect on the service costs and/or the rent have to give their permission (Hoppe et.al, 2008). A sustainable renovation project is usually performed in one building complex which share service costs for common areas and facilities. A building complex is a group of dwellings which are grouped together mostly in the same building block or a combination of several blocks.

⁵ The Value Property System (Dutch: woningwaardeeringsstelsel) is a points system which reflects the quality of a rental and determines the maximum rent. The points are based on items like surface, number of rooms, insulation etcetera.

1.5.1 Problems

To meet the goals mentioned in the covenant, a large part of the Dutch housing associations have determined sustainable goals. These sustainable goals can be implemented into the stock policy of the housing association, or can be met by performing sustainable renovations on project basis, apart from other work. Atriensis (2012) did a research on the implementation of sustainable policies among employees of 35 housing associations. This research concluded that over 80% of the associations have a sustainable policy plan. However, only 62% of these associations with a plan have prepared an implementation plan. Also 58% of the respondents indicated that the covenant goals will not be reached or that they do not know if they are going to meet the goals. According to the percentages mentioned in the research the implementation of sustainable policies faces problems, with the result that the covenant goals are not reached. Even when the association has implemented an energy policy, they are not always convinced about meeting the goals. Besides Atriensis, more research was done on problems in the implementation and execution of sustainable policies and sustainable renovation projects of housing associations.

According to Sunikka (2006) there is an important factor that influences the implementation of a sustainable policy within housing associations in the Netherlands. This is the lack of market demand and the willingness to make any extra investments in sustainable improvements. Within the rental sector, this problem is extra difficult because of the 'split incentive'. This means that the investment and the benefit do not go to the same parties. The housing association invest in sustainable improvements, but the tenant benefits because of his decrease of energy costs. This difference could be compensated by passing costs to the rent.

In 2010, Tambach published an assessment of the current Dutch energy transition policy instruments for the existing housing stock. One of the sub-questions of this research was: "What are the barriers and needs of the local executive actors to adopt energy efficiency improvements". The first fear of the representatives was that 'traditional work patterns in housing associations' and 'unclear communication' would lead to 'non-commitment of residents', and stated that 'all renovation activities should be bundled by one organization' and that the 'split incentive' would function as investment barrier. Other mentioned factors were a lack of integrated, standardized building components and a poor yield (Tambach, 2010).

In 2012, Atriensis published their survey results about the implementation of an energy policy within housing associations. This survey was filled in by employees of 60 Dutch associations with a joint housing stock of almost 600.000 houses, and therefore a broad sample. The main conclusions of this survey were that for the associations, it is an intensive process to convince the tenants to participate in energy saving projects which form a barrier for the associations. Furthermore, it is not always clear for the associations how to pass on the costs to the tenants and how to calculate a possible rent increase (Atriensis, 2012).

1.5.2 Tenant participation as problem focus

Many of the experienced barriers described above, are to a greater or lesser extent related to the role of the tenants within the sustainable renovation process. Also mentioned in section 1.2, the participation of tenants is important and stated by law. So when project leaders talk about 'non commitment of tenants' and 'the intensive process to convince the

tenants' they do not mention a factor which only forms a delay in the process, but a factor that can cause a total stop of the renovation project.

This problem will form the focus of this research, in which the effect of the project plan on the tenant participation is researched.

1.6 Atriensis

This graduation research is performed in cooperation with Atriensis. Atriensis is a consultancy company focused on energy issues within the Dutch association sector. They are specialized in advising in the field of energy labels, energy policies, sustainable renovations and behavior. Within this research, they provided contacts with employees and managers from several housing associations and insight in the content of several sustainable renovation projects.

2 Research plan

This graduation research is structured following a predetermined design. This design will be described in this research. First, the problem statement will be highlighted, subsequently the research questions are mentioned and the design of the research is elaborated. After that the relevance of the study and the reader manual are mentioned.

2.1 Problem statement

In the introduction is mentioned that the performance of sustainable renovation projects at housing associations is not always optimal. An important barrier within this process is the need for the approval of at least 70% of the tenants concerned with the renovation. However, this approval rate is not always achieved. Associations make efforts to convince their tenants to participate, it is the question however if they make the right decisions to do this in an effective way and if they have enough insight in the consequences of their decisions when it comes to tenant participation.

2.2 Research questions

Assuming that the responsibility of convincing the tenants to participate in the sustainable renovation project lies with the housing association, this study has the aim to make statements about improving the project plan of these sustainable renovation projects. This is because this plan is the mean the housing association has to approach the project and on which the tenants react by participating or not participating. This leads to the following main question:

How can a sustainable renovation project be composed in order to encourage the tenants to participate?

Based on experience from Atrienis, the design of a sustainable renovation project is done by a project group of the housing association, possibly supplemented with specialists. The project manager has the leading role in this. When a project leader works several years on renovation projects, he or she has valuable experience with the plans and the tenants. So besides literature and other existing documents, their experience is valuable and will be used in this research. Keeping this in mind the following sub questions are drafted to support the main question:

1. *What does a sustainable renovation project consist of?*
2. *Which factors influence tenant participation?*
3. *What is the effect of the project plan on the tenant participation?*
 - 3.1. *According to the literature*
 - 3.2. *According to project managers*
4. *Is it possible to forecast the effect of a project plan on the tenants' participation?*

2.3 Research design

The content of a sustainable renovation project will be derived from literature study. Also the influential factors on tenant participation are based on literature study. This will lead to a preliminary statement on the influence of the project part on the tenant participation. Thereafter, the effect of the project plan parts on the tenant participation according to the project leaders will be researched using applications of the Analytic Hierarchy Process. After this an attempt will be made to forecast the effect of a project plan on the tenant participation by applying case studies as alternatives within the AHP. These results will be

compared with the real participation of the tenants in these cases. The conclusions and statements derived from the research components lead eventually to recommendations on the content of sustainable renovation project plans with the aim to increase the tenant participation.

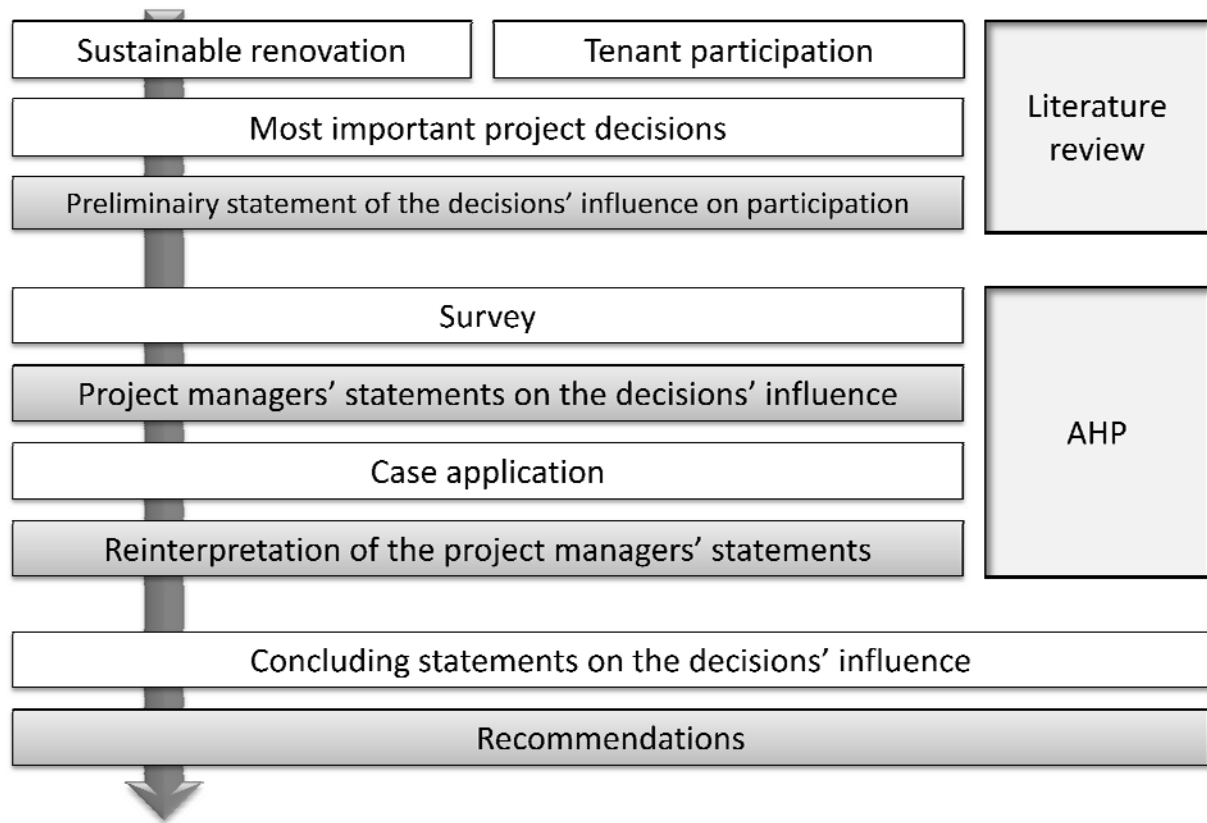


Figure 1 Research framework

2.4 Relevance

Although tenant participation is researched in several researches, less was looked at the viewpoint from the project managers. Besides that their experience is of great importance, they are also the key players in the decision making process of the sustainable renovation projects. It is the responsibility of the housing association to convince enough tenants, so it is relevant to look at their means to give content to the plans.

For housing association it is of importance to get more insight in how they can give content to their project plans and encourage their tenants to participate. Herewith, the projects can be designed in a more efficient way. Because the effort to convince tenants afterwards will be less and more dwellings can be renovated at once. This will also lead to a higher satisfaction of the tenants, because a smoother execution of the sustainable renovation projects is also in their benefit. However, the housing associations and their tenants are not the only stakeholder that benefits from the insight gained in this research.

The overarching goal of this research is to contribute to the world wide environmental problems caused by the emission of CO₂. When the execution of the sustainable renovation project improves, the energetic performance of these dwellings improves, leading to less CO₂ emission of this part of the built environment. This is a benefit for the whole society.

2.5 Reader manual

In chapter 3, sustainable renovation projects and the most important decisions a housing association has to make when it comes to these projects are described. In chapter 4 will subsequently tenant participation further be elaborated. The criteria which have influence on this participation will be described. This chapter ends with a connection between the project parts and their influence on the participation. This is mentioned in a preliminary statement at the end of chapter 4. In chapter 5, the preliminary statement is used to apply in the Analytic Hierarchy Process. In this chapter the data derived from the survey is further processed into statement according to the project leaders. In chapter 6 five cases will be applied on the data from the previous chapter to test the derived data. The final conclusions and recommendations will be described from chapter 7.

3 Project decisions

As mentioned in the introduction, sustainable renovation will in this research be defined as:

“A renovation in order to transform an existing building to fulfil the requirements on the field of the energetic performance and the health and comfort of its users while achieving economic viability”

This sustainable renovation plans are the result of the associations' energy policy and their plans with the building complex.

To get insight in the content of sustainable renovation projects, several project descriptions are analyzed. A sustainable renovation plan always consists of at least the following four aspects: a technical part in which the current condition of the building complex and the proposed measures are described, a financial part in which the return on investment for the association and the financial consequences for the tenants are calculated, a tenant approach plan in which the actions in order to inform the tenants about the plans and a participation policy is included, and an execution plan in which the schedule but also the nuisance limitation is included. These four aspects will be described in the following sub sections.

3.1 Technical decisions

There are several options to renovate a dwelling, and meeting the objectives of the energy performance and the needs for comfort and health of the tenants. Since associations are more aware of the necessity to invest in improving the energy performance, this is often the main goal of the renovation. However, often these improvements are included in other renovation or maintenance schedules, causing that most renovation projects are a combination of energy saving and other dwelling improving activities.

An important characteristic of every improvement is that it can be applied on an individual or on a collective level, or both. This is important for the association because when less than 70% of the tenants want to participate it is still possible to apply the individual improvements. However, communal improvements affect every tenant within a building complex which means that a participation level of more than 70% is crucial. Below, the most common energy saving improvements are listed with a short description.

Table 1 Possible sustainable renovation improvements

Improvement	Description
Individual	
HR++ glass	Double glass with a metal layer to keep heat radiation from the sun outside. The cavity is often filled with a gas such as Argon or Krypton.
HR107 boiler	A gas boiler with a higher efficiency than conventional boilers. The HR107 gas boiler is currently the newest model.
Seam sealing	With tape, a rubber strip or PUR, seams can be covered in order to limit heat loss.
Semi individual	
Wall insulation	An insulating mixture is injected into the wall cavities.
Roof and floor insulations	Insulation packages are attached to the roof and floor.

PV panels	Radiation from the sun is absorbed and converted into electricity.
Solar boiler	Radiant heat from the sun is used to heat water.
Mechanical ventilation with heat recovery	Mechanical ventilation ensures a continuous air renewal resulting in a less moist and healthier indoor climate.

Communal

Heat pump	A heat pump withdraws heat from ground or surface water, outside air or the earth ground.
Collective heat water system	No individual boilers are necessary which saves costs and space. Often the necessary heat energy is derived from industrial processes.

As mentioned above, sustainable renovation is often combined with other types of improvements, not directly related to energy efficiency. This is because sustainable improvements are often integrated in the general maintenance and renovation cycle of the housing association. In Table 2 examples are given of other renovation or maintenance work which is often combined with energy saving improvements.

Table 2 Possible renovation improvement

Improvement	Description
Individual	
Renovation kitchen/toilet/bathroom	Replacement of the installations and wall finishing.
Layout improvements	For example demolishing of a partition wall or increasing the balcony surface.
Painting or replacing window frames	Wooden window frames will be painted or replaced by plastic window frames. Metal window frames could also be replaced.
Remove materials that contain asbestos	Behind the wall/floor finish is often asbestos present. When the finishing is replaced, the asbestos should be removed.
Communal	
Staircase	Improvements to the communal staircase are for example new paint or a new wall/floor finish
Other communal rooms	Communal rooms like corridors or storages could use a new painting or finish.

3.2 Financial decisions

As mentioned in section 1.2, the rent of social dwellings has a limit (€981.02 monthly in 2013). This gives a restriction to the possibilities to pass the investment costs of the renovation to the rent. However, even when the rent of the dwelling has the possibility to increase, the association has to make a decision about the calculation of the costs and the rent increase.

An association can decide not to increase the rent for the present tenant, but only at mutation (moving out of the present tenant). The main reason to make this decision is to

encourage the tenants to participate. When the investment is passed to the rent (for the present tenant, at mutation or both), there are several ways to calculate and communicate this rental increase, which will be described in the following sections.

3.2.1 Percentage expected saving

Often, the rent increase is calculated on the basis of the expected saving on energy costs, due to the energy saving improvements. This percentage differs between different associations and different projects, but most of the times lay between 50% and 75%. For example, when the improvements result in a saving of €12.- a month on the energy bill, the rent increase is €9.- when 75% of the expected saving is passed to the rent. The aim of this calculation method is that the integrated housing costs in total decrease for the tenant (see Figure 2).

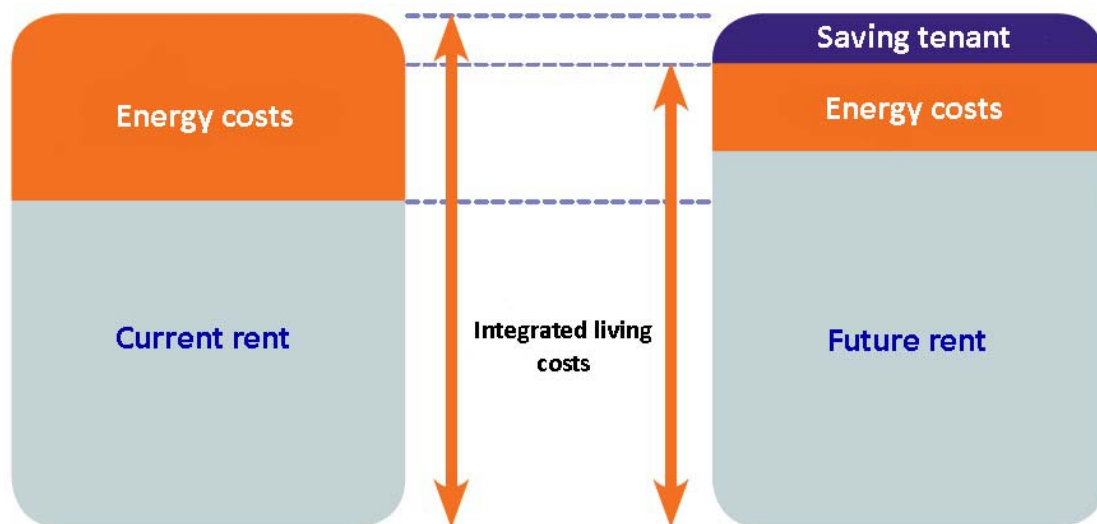


Figure 2 Possible saving on the integrated housing costs

Within this calculation, it is important how the association calculates the expected savings. The impact of the improvements is mainly calculated by indicators. However, the decrease of energy costs is also to a great extent depending on the behavior of the tenant. In some cases, the association uses real user data, gained from the energy supply company or from the tenants themselves. In other cases, the calculation is based on averages for the building complex or dwelling type. In these cases it is possible that the expected saving and the real saving differ a lot after the improvements are applied.

3.2.2 Percentage investment

Before executing the improvements, it is important for an association to have an overview of the total investment costs and the payback time. Some associations use this calculation also in order to calculate the rent increase. Simply put, the rent increase becomes the investment costs of the improvement divided by the depreciation time. When an association calculates their rent increase this way, they have two main issues to take care of. The first is the decision whether to pass the total investment costs to the rent or only a part of it. This decision is very dependent on the second issue: the communication of the rent increase to the tenant. Although associations use this calculation method to determine the rent increase, in the communication to the tenants often they still use the expected savings and

mention that the rent increase is lower than the expected saving. So when the rent increase is calculated, this should not rise above the expected savings.

3.2.3 Amount per label step

In 2011 the Implementation Act Rental Housing (Dutch: Uitvoeringswet huurprijzen woonruimte) was amended. Where previously the energy performance of a house did not have a great influence on the rent, since 2011 a green label delivers a substantial bonus in the form of additional property valuation points. The goal of this amendment is to stimulate house owners to invest in energy saving improvements. The extra points should result in rental increase and thus cover (a part of) the investment costs. Most of the time, the property valuation does not matter for current tenants, because the rent increase is mostly derived from expected saving.

This is different at mutation. Associations determine the new rent as a percentage of the maximum reasonable rent⁶ (Dutch: maximal redelijke huurprijs) which is determined by the property value points. By charging the extra value points to the rent, the new rent including the energy saving improvements is calculated.

Table 3 Value points per label

Label	A++	A+	A	B	C	D	E	F	G
Value points single family dwelling	44	40	36	32	22	14	8	4	0
Value points more family dwelling	40	36	32	28	15	11	5	1	0

An example: based on the improvements, an expected saving of €20.- per month is calculated. The current tenant pays 50% of this amount which means a rent increase of € 10.- per month. The energy label increases from D to C, which means 8 extra property value points. The association uses €4.- per point per month as target rent. At mutation, the rent is therefore increased from €10.- per month to €32.- per month. With such forecasts and shifts of benefit to the future, it is important to have insight in the local housing market and housing allowance in the future.

3.2.4 Inconvenience fee

When a renovation is performed and the tenant is hindered by it, sometimes the association compensates this nuisance by an inconvenience fee. An example is a fee for the fact that the tenants have to move their furniture when the dwelling should be emptied before the work can start, or a fee to compensate the use of water and electricity by the construction workers during the work. The fee is dependent on the type and duration of the work and the policy the housing association has on this field. The level of compensation can differ a lot from a few tens to thousands of Euros.

⁶ The maximum reasonable rent is dependent of the quality of the dwelling, derived from the number of property value points. The rent may never be higher than the maximum reasonable rent. Often the rent is to some extent lower. This has to do with the rentability of the dwelling and the income of the tenants.

3.3 Tenant approach

As mentioned in section 1.2, it is stated by law that 70% of the tenants have to give their permission for the renovation before the renovation can take place. When a renovation plan is presented to the tenants, there are two possible results: less than 70% participates or more than 70% participates. When less than 70% participates, the individual measures can only be applied at the dwellings that participate. The renovation of the other dwellings will have to wait until mutation. The communal measures cannot be applied, unless the costs for these measures will not be passed to the rent. However, when it is necessary to perform the work inside the dwellings it is not possible because of the refusal of tenants. This is for example when pipelines have to be renewed.

When more than 70% of the tenants give their approval, it is possible to force the remaining tenants to participate. This is desirable when communal improvements are applied. The costs can then be passed to the rent of all the tenants. When the improvements are individual, it is also possible to perform them only at the dwellings that gave permission and renovate the remaining houses at mutation. However, to execute as much work as possible at once, it is desirable that as much as possible tenants participate in the plan. Therefore an association has several means to communicate the plan to the tenants and to pursue the tenants to participate. Communication to the tenants is therefore crucial. Also the extent to which tenants have a say in the project plan has to be decided during the process. Both subjects will be discussed in the following sections.

3.3.1 Communication

The communication of the project plans to the tenants is very important to let the tenants participate in the plan. Often, tenants from social housing are from foreign origin or elderly (Werf, 2011). It is also possible that because of the low income of most of the tenants their education level is also low. It is necessary to adjust the communication tools to the type of tenant. Tools to communicate to the tenants are for example: a letter, leaflet, survey, information evening, consultation meetings, and a model dwelling.

It is useful to include a communication plan into the project plan. However, this is not done for every project plan. Often, communication is included in the plan of action and the schedule. The moment on which the first letter is sent, when the information evening will take place and when the permissions should be received are prepared. However, a plan in which the communication tools are adapted to the type of tenants is rare.

3.3.2 Tenants say

The extent to which tenants have influence on the project plans is depending on their level of influence, the moment of influence and the way they have a say in the decision-making process. Arnstein (1969) described the different levels of collaboration as a 'ladder of participation', from informing to co-voting. The higher the tenant stands on the 'ladder', the bigger their influence is on the project decisions. The moment of influence is important because in general, tenants have more influence when they are involved at the beginning of the development of the plans than when they are involved at the end.

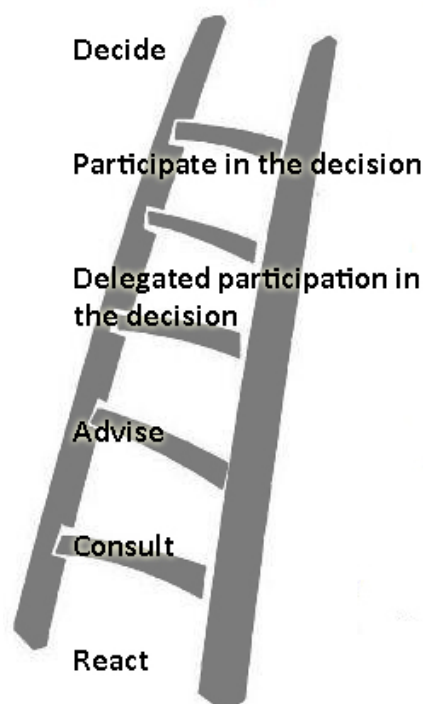


Figure 3 Ladder of participation (Arnstein, 1969)

Most of the times, housing associations make use of several levels of participation. The first is involving the tenant according to the Consultation Law (Dutch: Overlegwet). This is obligatory for changes in the rental policy and contains inter alia the 70% regulation. The law states that tenants have the right to be informed about plans from the property owner. This informing is often expressed via a letter to the tenants in which the project is mentioned. This letter can include an announcement for an information evening in which the plans are further explained.

The second level is consultation of the tenants. For example, this can be done via a survey or by involving the tenants via an interest group, which can be composed at the beginning of the renovation project, or can already exist in the form of a tenants association for the building complex. This group consists of tenants who represent all the tenants of a building complex. Via meetings the input from this group is gained. The survey is a questionnaire which can contain questions about the tenants' thoughts on the renovation project, complaints about the current condition of the dwelling, the living comfort and satisfaction, their current attitude against the plans, etcetera.

The third level is giving the tenants a (part of the) vote during the decision-making process. This can vary from letting the tenants choose which color the communal spaces will be paint, to which contractor will be granted the project. This type of participation asks for a clear communication and organization of the process, but can lead to a larger involvement of the tenants with the project plans.

3.4 Execution decisions

The decisions with respect to the execution of the renovation can be partly included in the project plan. However, parts of the execution can also be left to the contracting party. Often, preconditions are set by the housing association, for example the duration of the work.

Tenants are reluctant to the nuisance of the renovation. Therefore, the association can take specific measures to limit the nuisance caused by the execution. Decisions the association can make are for example: help with the movement of furniture, placing of waste containers when for example an attic has to be cleaned up, a key service so that the tenant does not always have to be home when the work is in progress and the combination of improvements with other work. Within the communication to the tenants, it can be helpful to include a description of the work conditions. Hereby, tenants will have insight in where they stand during the work.

3.5 Conclusion

In preparation of a sustainable renovation project, a project plan is made up. In this section, an answer on the research question is given:

“Where does a sustainable renovation project consist of?”

A project plan consists of the technical improvements, financial calculations, tenant approach, and execution decisions. For each part, the association can make different decisions. The technical decisions consist of individual or communal energy saving improvements, possible supplemented by other maintenance or renovation work like kitchen renovation or a paint job. The financial decisions include the pass of the investment costs to the rent for the current tenants and after mutation. This can be calculated as a percentage of the expected savings on the energy bill or as a percentage of the investment costs. It is also possible not to pass the costs to the rent for the current tenants. This encourages the participation, however does not solve the problem of the split-incentive for the period until the current tenant moves. Rent increase after mutation is often calculated on the basis of the increase of property value points. As an extra incentive, housing associations can provide an inconvenience fee to compensate for the nuisance of the renovation.

In the project should be mentioned how the tenants are approached. It is desirable that the communication is adapted to the type of tenants, for example when they are elderly or from foreign origin who have difficulties with the Dutch language. The level of participation of the tenants within the renovation process can differ. It is possible that the tenants are only informed about the plans, that they are consulted, or that they have a say in the plans. Often, an interest group is composed at the beginning of the renovation process. The decisions concerning the execution are globally described in a project plan, but to a great extent left to the contracting party. The planning of the project and nuisance limitation are important aspects of the execution.

The different aspects of the project plan can have an influence on the tenant participation. A research on the aspects that have influence on the tenant participation in sustainable renovation projects and the role of the project plan in this decision are described in the next chapter.

4 Tenant participation

In this chapter, an overview of the tenant participation and influential factors on this participation is given, based on the available literature. To give structure to this chapter, Figure 4 was designed. The figure is based on the following statement: when the project plan matches the needs and interests of the tenants, the tenants are inclined to participate in the sustainable renovation plans (based on Werf, 2011). There are factors that have an influence on the tenants' needs; these can be called tenant dependent factors. There are also factors that influence the project content; these can be called project dependent factors.

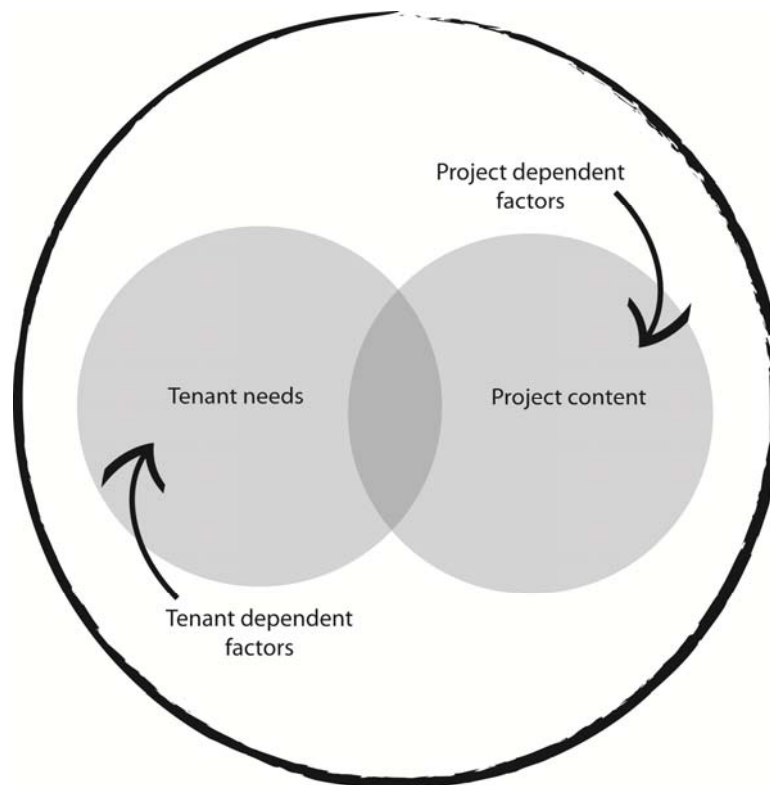


Figure 4 Overlap of the tenant needs with the project content

In this chapter, the tenant dependent factors are described first. This leads to the tenants' needs when it comes to renovation projects. Next the project dependent factors are mentioned and how this leads to the content of the sustainable renovation project. Last, feedback will be given on the relation between the project content and the tenant participation.

4.1 Tenant dependent factors

Tenant dependent factors are aspects that are connected to the tenant, like the characteristics or the attitude of the tenant. They do not have a direct connection with the sustainable renovation plan. However, the factors have influence on the attitude and possible resistance of the tenant when it comes to the project plans. In this section the tenant characteristics are described first and subsequently how these could lead to resistance of the tenants.

4.1.1 Tenant characteristics

The first group of characteristics of the tenant is the *socio demographic characteristics* like age, gender, marital status and household composition (Werf, 2011). These characteristics

have an influence on the willingness of the tenant to participate in a sustainable renovation project. For example, for a family with young children, the willingness to participate and thus face the nuisance and inconveniences can be lower than for a single person. People who are at home often, like elderly, could also have more problems with the nuisance of a renovation because they have to face it during the whole day. However, because they are at home more often it is also conceivable that they benefit more from the increase of living comfort. Therefore it is not possible to say that a certain characteristic of a tenant always has a positive or negative influence, because this can differ from person to person.

The *financial situation* of the tenant is important in the decision to participate or not. For example, a low-income family will have more interest in the financial incentive than a family with a middle income. However, the financial incentive of a sustainable renovation is based on a prediction on the energy use saving made by the housing association. The quality of this prediction determines to what extent this corresponds with the real energy use saving. For a tenant this can be perceived as a risk. A tenant with a low income is less willing to take a financial risk than a person with a higher income or with savings (Werf, 2011).

The *environmental awareness* of the tenants is also important. De Groot et.al. (2008) composed four profiles of environmental awareness.

- Ease: “comfort and ease are very important for me and there is no urge to save on energy costs or worry about the environment”
- Conscious: “comfort is of importance but I am trying to save energy and I am aware of the environment”
- Costs: “I am aware of the increasing energy prices and try to save energy to reduce costs”
- Environment: “I save energy because I am very aware of the environment and the changing climate”

Subsequently, van der Spank (2013) investigated the relative importance of different aspects of a renovation project to making the choice to participate or not. Below, the results are presented. Van der Spank chose to take dwelling expansion, renovation of living spaces, sustainable solutions, nuisance during the renovation, and living-costs savings as most important influential aspects on the tenant participation. The percentage represents the relative importance of the aspect on the choice of the tenant. Figure 5 shows that people with a different environmental attitude find different aspect important in their decision to participate or not.

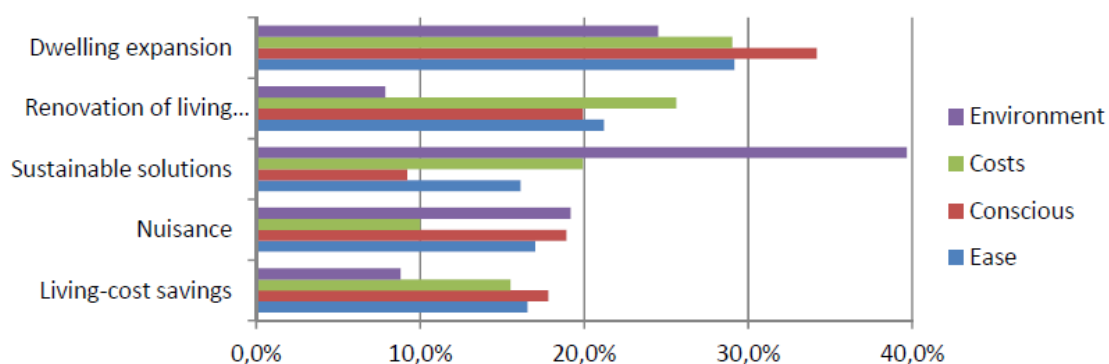


Figure 5 Relative importance of the influential criteria on tenant participation per respondent group (Spank, 2013)

Within the same research the average relative importance of the aspects was also investigated. It is important to mention that the four different tenant groups were not equally represented which made that the values in Figure 6 are calculated according to the size of the respondents groups. The representation of the groups is as follows: environment: 9.6%; costs: 25.1%; conscious: 58.3%; ease: 7.0%.

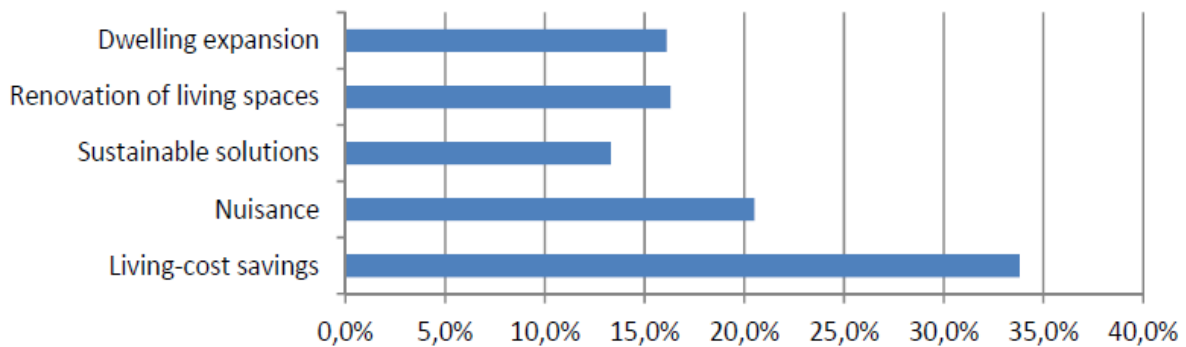


Figure 6 Average relative importance of influential criteria on tenant participation (Spank, 2013)

Figure 6 shows that on average, tenants find the living-cost savings the most important factor in the decision to participate. After that, the nuisance during the renovation is considered to be important. The dwelling improvements are the least important, whereby the dwelling expansion and the renovation of living spaces (including kitchen and sanitation) have a comparable importance and the sustainable solutions are considered to be the less important.

4.1.2 Resistance

When the renovation project is announced, it is possible that the tenants react negative and reserved. Often, this restraint is not directed to the renovation itself, but against the change connected to the renovation. Change leads to feelings of insecurity which most tenants do not like (Dijkstra, 2010). This restraint factor due to the change factor of a project is also dependent on the attitude of a tenant. A person with a suspicious character can have a bigger resistance against change than a more relaxed person. According to Dijkstra (2010), resistance can be caused by doubts of the tenant. These doubts can be against the problem (the tenant criticizes the necessity of the renovation), the need, effectiveness, feasibility and suitability of the chosen measure, or the justice of the policy (the tenant thinks the rent increase is not fair).

Schillemans et.al. (2006) also described restraints from tenants towards renovations, but focused on the tenants' behavior towards sustainability and energy savings. The authors also reported a long period of nuisance or moving-out as a negative influence on the participation. Also, tenants are not always convinced that sustainable measures contribute to lower energy costs or a healthier indoor environment. This is also due to the fact that not all tenants have sufficient knowledge about their energy bill and the effects of energy saving measures (Schillemans et.al, 2006).

The tenants' resistance can also be caused by their relationship with the housing association. It is possible that a previous experience, for example a bad executed maintenance, has caused a basic resistance of the tenant against the plans of the association. Although this has

nothing to do with the current content of the renovation plans, it can have a negative effect on the tenants' decision to participate (Dijkstra, 2010).

4.2 Tenants needs

In a sustainable renovation project the needs of a tenant are of interest. These needs are to a certain extent based on the tenant dependent factors. However, there are also some general needs for a tenant which are described in this section. The first need is the need for understanding of the sustainable renovation plans, the second need is benefit and the last need is the limitation of nuisance. These needs are described in the following sections.

4.2.1 Understanding

According to Dijkstra (2010) tenants do not think in technical terms (HR++ glass, HR-boiler, EPC, R-values) when it comes to sustainable improvements, but in terms of comfort ('there is draft in the hallway', 'the bathroom is always humid', 'my feet are cold in the evening'), ease of use ('such a modern thermostat is difficult to use') and nuisance ('can I do my laundry during the renovation').

Furthermore, it should be taken into account that the tenants of social housing are for a large part elderly, low-income families and immigrants (Werf, 2011). The communication towards these tenants should be easy and clear to understand. Schillemans et.al. (2006) stated that the lack of knowledge about energy use and sustainable solutions are a problem for all tenants. This increases the necessity of clear communication and expressions in line with the perception of the tenant.

4.2.2 Benefit

The second requirement mentioned in this section is the benefit for the tenant. A high benefit has a positive effect on the participation of the tenants. Van der Spank (2013) showed a list of the benefits for a tenant after a (sustainable) renovation.

Table 4 Possible benefits after renovation (Based on Van der Spank, 2013 and Werf, 2011)

Tenants' benefits after renovation	
Reduction in living costs	Lower energy costs
Higher living comfort	Healthier indoor climate
	Extension of the living space
	Improvement of kitchen and sanitation
	Lifelong durability of the dwelling
Environmental	A more energy efficient living environment

The benefit of the tenants is also dependent on the initial situation of the dwelling. The expectation is that tenant will participate more likely in a renovation project when their dwelling is currently in a bad condition than when it is in a better condition and the tenants do not have inconvenient feelings or complaints about their dwelling (Werf, 2011).

4.2.3 Nuisance limitation

A limitation of sustainable renovation project is that they are mostly performed at occupied dwellings. Thereby it is important to keep in mind the inconvenience and nuisance this gives

for the tenant and when this is too much. For a tenant, too much nuisance can cause non-participation (Werf, 2011). The need for nuisance limitation is therefore important.

Nuisance limitation is applicable before, during and after the renovation. Examples of limitation before a renovation are help with moving furniture or the covering of a floor. During the renovation a key service can be offered which ensures that the tenant does not always have to be home to let the construction workers in. After the renovation a good care of the finish, again help with moving the furniture or a fast processing of complaints is important.

4.3 Project dependent factors

Project dependent factors have an influence on the content and implementation of the project plan. These factors fall to some extent outside the boundaries of this study. However, to get a better understanding of the bigger picture and the conditions in which the project plans are established, this section will shortly describe two project dependent factors: the strategic asset management and the responsibility of the renovation within the association.

4.3.1 Strategic asset management

The strategic asset management is the way a housing association keeps their housing stock in the long and short term compliant with the evolving market demand and objectives of the associations. This also includes the objectives in the field of quality, living comfort and energy performance of the dwellings. First, the objectives are determined on a strategic level, which means on the level of the total stock and by the policymakers of the association. Subsequently, the goals on a strategic level are translated in objectives on building complex level. The execution of the work to meet these objectives is then left to project leaders. It is possible that an association has determined standardizations for their projects. For a sustainable renovation these standardizations can include the type of improvements or the policy on rent increase.

The standardization of parts of the sustainable renovation projects might prevent that a project plan can be fully adapted to the specific needs of a tenant. However, a clear and standardized policy provides a clear basis for a project plan.

4.3.2 Responsibility

Every renovation project is managed by a project leader, who is the spindle of the project and the connection between the managing directors, the construction workers and the tenants. Despite the fact that the final responsibility lies eventually at the management level, it is the project leader who makes most of the decisions concerning the project. Therefore, the project leader has to create a balance between the interest of the association and the tenants. The preconditions of the project come from the association, for example the desired energy label. However, from legislation the participation of at least 70% of the tenants is also a precondition on which the project leader must anticipate. It is therefore important that the project leader has knowledge about the consequences of his decisions on the tenant participation. The interaction and communication between the project leader and the tenants can have an influence on the participation rate.

4.4 Project content

Within the boundaries the association sets for the project, the project leader has the freedom to give substance to the project. In chapter 3 the different decisions that can be made within a sustainable renovation project are described. In this section a link will be established between the project content and the tenant participation. The tenant participation and the influence the project parts have on this participation are described, according to already existing researches. The influence will eventually be classified in 'low', 'medium' and 'high'.

4.4.1 Technical decisions

As mentioned in section 3.1, the technical decisions can be individual, semi individual or communal. Also, improvements for decreasing the energy consumption are often combined with other improvements like renovation the kitchen or the lay-out of the dwelling, paint jobs and the removal of asbestos. In section 4.1 van der Spank (2013) found that dwelling expansion, renovation of living spaces and sustainable solutions respectively contribute 16%, 16.5% and 13% to the decision to participate, compared to the two other factors nuisance and living-cost savings. As mentioned in section 3.2.1 tenants do not think in technical terms but in terms of comfort. Werf (2011) stated that the influence of the improvements on the living comfort is of great importance when choosing to participate in a renovation process. According to Schalkwijk (2009), comfort is one of the most important influential factors when it comes to participation in wall insulation. The influence the insulation has on the indoor climate herein is of interest.

Within this research the technical decisions will fall in the category 'dwelling improvement'. This is further divided into 'lay-out improvement', 'improvement of facility spaces' (like kitchen and bathroom) and 'improvement of the energy performance'. According to the above mentioned statements, the influence of the dwelling improvements are considered to be 'medium'.

4.4.2 Financial decisions

In section 3.2 the financial decisions are described. For an association the calculation of the investment costs and the return on investment are important. However, from the tenants' point of view the most important financial aspects are the rent increase and the decrease of integrated housing costs caused by a decrease of energy costs. Also the inconvenience fee for nuisance or moving out can have an influence on the decision of the tenant to participate.

Van der Spank (2013) has shown in section 4.1.1 that for the average tenant, the living-cost savings are the most important (33.5%) factor in the decision to participate. Because a large part of the tenants of social housing have a low income, the financial part is always very important. However, the aim of a sustainable renovation is to lower the integrated housing costs of a household. As mentioned in section 4.2.2, benefits for the tenant are crucial in their decision. According to Schalkwijk (2009) the financial aspects have a great influence on the consideration to participate. This statement is confirmed by Werf (2011) who considers both these aspects of great importance for the tenants' choice. She also mentions a possible inconvenience fee to be a part of the financial aspects. However, in comparison with the influence on the monthly housing costs, this fee is of much less importance. The importance of the financial aspects is also confirmed by Quirijns (2011) who stated that the financial aspects and the benefit for the tenant are of importance.

Within this research the financial aspects are further divided into the level of inconvenience fee, the level of energy costs savings and the level of rent increase. The total influence of the financial aspects is considered to be 'high' wherein the influence of the inconvenience fee will be considered as 'low' because literature has mentioned this aspect not as one of great importance.

4.4.3 Tenant approach

In section 3.3 the tenant approach is divided into communication and the tenants say. When it comes to tenant approach, Werf (2011) states that especially the degree of influence the tenant has during the process is of great importance and the choice options for tenants have a large share in this. Werf states that the quantity and way of education and communicating with the tenants has a little influence on the decision making process.

In section 4.1.2 it is mentioned that tenants are not always convinced that sustainable measures contribute to lower energy costs or a healthier indoor environment which is also due to the fact that not all tenants have sufficient knowledge about their energy bill (Schillemans et.al, 2006). According to Dijkstra (2010) resistance can be caused by doubts of the tenant. Because of the possible resistance and the need for clear information of the tenants the tenant approach is of importance for the tenant participation.

Within this research the tenant approach is further divided into the 'frequency of communication', the 'type of communication' and the 'tenants say'. The total influence of the tenant approach is considered to be 'medium' in which the tenants say is 'high' and the frequency and type of communication is considered to be 'low'.

4.4.4 Execution plan

In section 4.1.2 it is mentioned that a long period of nuisance or moving-out has a negative influence on the participation (Schillemans et.al, 2006). This is confirmed by Quirijns (2011) who mentioned fear for nuisance and inconvenience as influential aspects in the decision-making process of the tenant. Schalkwijk (2009) mentions as influential execution factors: the effort for the tenant, time, nuisance and clutter. While these factors have an influence, they are not considered as crucial factors. Werf (2011) also sees these aspects also as influential factors however the influence is little to average.

Within this research the execution plan will fall under the category 'nuisance' because this is the factor that influences the tenant participation. Nuisance is further divided into 'duration', 'decrease of living convenience' and 'preparatory activities'. The total influence of the nuisance is considered to be 'low'. Also the influence of the duration, decrease of living convenience and the preparatory activities are considered to be 'low'.

4.5 Preliminary statement

In the previous section a link has been established between tenant dependent factors, tenant need, project dependent factors, project content and their influence on the participation of tenants in sustainable renovation projects. In general, it can be said that a project plan evokes a certain consideration of the tenant which is based on the project content and the tenant itself. This is shown in Figure 7.

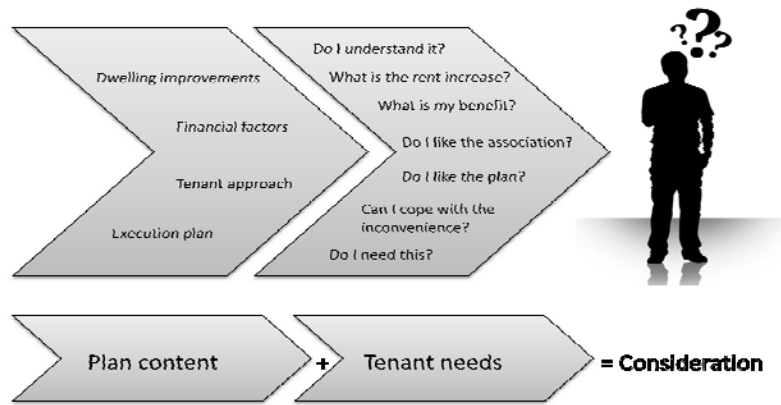


Figure 7 Plan content in combination with the tenant needs lead to a consideration of the tenant

Independent of the tenant factors, a project plan has a certain influence on the consideration of the tenant (see section 4.4). This is interesting because a project plan is not adapted to every tenant individually and a project plan focusing on a group of different types of tenants.

On the basis of the statements in section 4.4, a model is derived in which the different aspect of a project plan and their influence on the tenant participation are shown (see Figure 8).

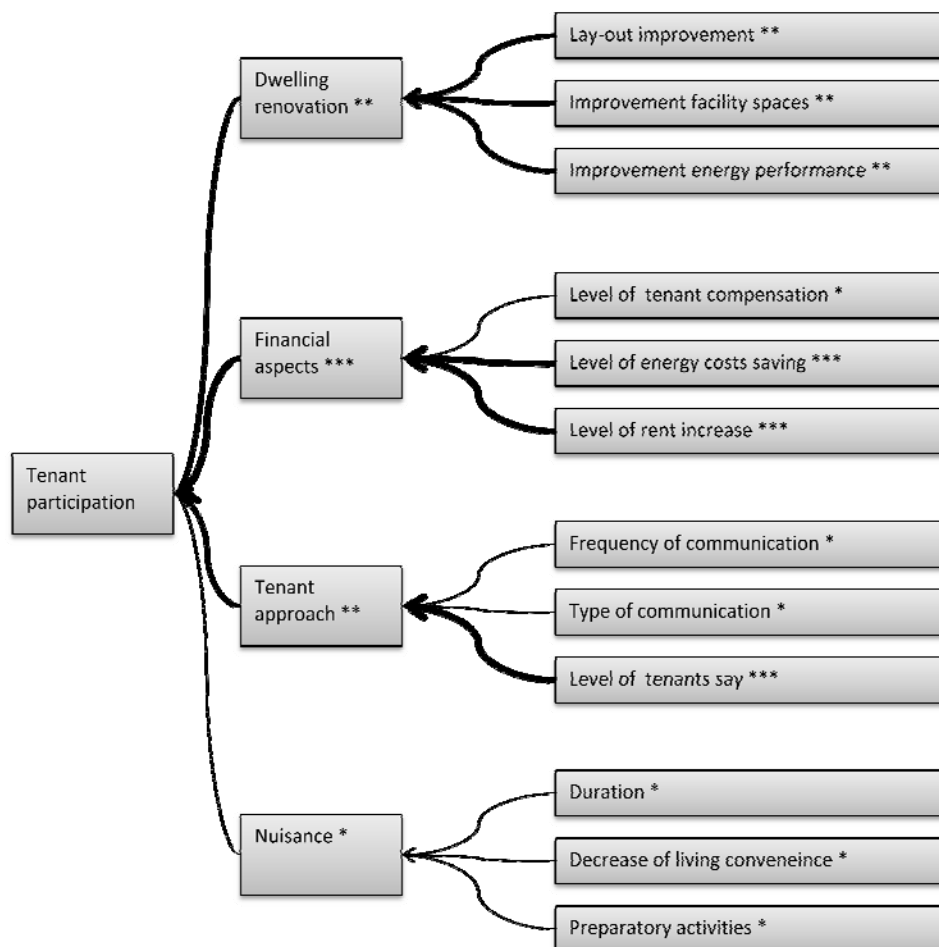


Figure 8 Preliminary statement about the influence of the project parts on the tenant participation (*low influence, ** medium influence, *** high influence)

4.6 Conclusion

The tenant participation in sustainable renovation projects depends on several factors. These factors belong to the tenant him or herself, the tenants' needs or the project content, in which the relation between the project content and the tenants' needs is the focus of this research. In this chapter answers are given for the following research questions:

“Which factors influence tenant participation?”

In this chapter it is stated that the participation of a tenant is to a great extent dependent on the connection of the project content to the needs of the tenant. From literature the most important needs are described: understanding, benefit and nuisance limitation. When a tenant understands the project, how much benefit they want to have from the project or how much nuisance the tenant finds acceptable is dependent on the characteristics of the tenant and the level of resistance a tenant has. Tenant characteristics described in this research are for example socio demographic characteristics, the financial situation, and the environmental awareness of the tenant. In addition, the content of the project plan has influence on the tenant participation. In the next paragraph an answer is given to the following research question:

“What is the effect of the project plan on the tenant participation according to literature?”

In chapter 3 it is described that project plans generally exist of technical decisions, financial decisions, a tenant approach plan and an execution plan. This chapter shows how these aspects have an influence on the tenant participation. This is described in section 4.4. Section 4.5 subsequently gives a preliminary statement about the influence the project aspect have on the tenant participation.

The financial factors are considered to be the most important, especially the level of energy costs saving and the level of rent increase. The level of tenants say is also considered to be very important, in contrast to the other two aspects of the tenant approach: the frequency and type of communication. The most important aspects of the dwelling renovation (the layout improvement, improvement of the facility spaces and the improvement of the energy performance) are considered to be average important. The nuisance (duration, decrease of living convenience and preparatory activities) is considered to be less important.

The statements in this chapter are based on available literature. The next chapter will investigate how project leaders of sustainable renovation projects think about the influence of the project content on the tenant participation. Therefore, a survey was distributed to experienced project leaders. The design of the survey and the processing of the data are done on the basis of the AHP method, which will be further described in the next chapter.

5 The Analytic Hierarchy Process

The analytic hierarchy process (AHP), developed by Saaty (Saaty, 1980) is a popular decision support tools because of its powerfulness, simplicity, and potential of being utilized for a group decision-making process that involves multiple actors, scenarios, and decision elements (criteria, sub criteria and alternatives). The AHP requires a well-structured problem represented as a hierarchy with the goal at the top. The subsequent levels contains of criteria and sub criteria, while alternatives lie at the bottom of the hierarchy. The AHP determines the relative importance of set of (sub) criteria by employing pair-wise comparisons of the hierarchy elements at all levels following the rule that a given hierarchy level, elements are compared with respect to the element in the higher level by using a fundamental importance scale (Saaty, 1980). At the end, a ranking of the alternatives is made by multiplying the criteria specific idealized or normalized weight of the alternatives with the corresponding relative importance of the criteria and summing up the results to obtain the final composition of the alternatives' priorities with respect to the goal. The highest value of the normalized weight indicates the best ranked alternative (Srdjevic et.al, 2013).

In this research, the analytic hierarchy process will be combined with case study. Five case studies form the alternatives for the hierarchy model. Elaboration of these case studies, the weight of the criteria and sub criteria with respect to these cases and the idealization of the weights will therefore be described in the next chapter. This chapter contains the hierarchy model, survey and the processing of the data. First the application and the principles of the method will be described. Then the implementation of the data is elaborated including the results and conclusions.

5.1 Application of AHP

The AHP method is applied in construction projects in several ways, for example to find the best value-bid for a tender (i.a. Marzouk et.al, 2003; Lin et.al, 2008), to assess risks and uncertainties of construction projects (Zayed et.al, 2008) or to determine the best project contracting approach (Khalil, 2002). In this research, the hierarchy is structured with respect to the overarching goal: tenant participation. In this research is looked at project aspects that have influence on the tenant participation.

The AHP method will be applied to determine the project managers' perspective and the comparison to case study. This is an unusual application of the AHP method. However, the different steps of the APH give answer to the research questions. Table 5 shows the application of the different step of the AHP method in a general approach and in the approach of this study. Since this research application is unusual and not yet substantiated in literature, this study will also conclude a statement about the applicability of AHP in this research.

Table 5 Application of AHP in this research

Method step	General application	Research application
Hierarchy design	Structuring the overarching goal into criteria and sub-criteria.	Structuring the overarching goal into criteria and sub-criteria.
Pair-wise comparison	Determine the most important criteria according	Estimate the most important criteria according to the

	to the respondent.	respondent.
Alternative weighting	Weight the alternatives with respect to the criteria	Weight the cases with respect to the criteria.
Alternative ranking	Calculate the score of each alternative. The alternative with the highest score is the best alternative according to the respondents.	Calculate the score of each case. These scores form a mutual comparison between the performances of the cases. These performances can be compared to the real performances of the cases.
Method goal	Rank the alternatives and find the best alternative.	Rank the cases and compare this ranking with the real ranking.

As explained in chapter 4, the project parts influence the participation of tenants in the renovation project. Project managers know from their experience (or have assumptions about) the impact of the different decisions on the tenant participation. To identify this knowledge from project managers, a questionnaire was designed based on the principles of pair-wise comparisons belonging to the AHP method.

5.2 Principles of the method

In this section the principles of the method will be discussed, the application of the method on this research and the data will be discussed in section 5.3

5.2.1 Hierarchy model

To design the hierarchy model, the goal is put on the top of the model (see the example Figure 9). Then, the criteria of which the goal consists of or which have influence on achieving the goal are put in the second layer of the hierarchy. The next layer is a division of the criteria into sub-criteria are a part of the criteria which they belong to (Figure 9 does only have one layer with criteria). The lowest layer consists of the alternatives. However, in this research does not have the purpose to choose the best alternative (common when using the AHP method) but to compare the outcome of the method with the real tenant participation rate.

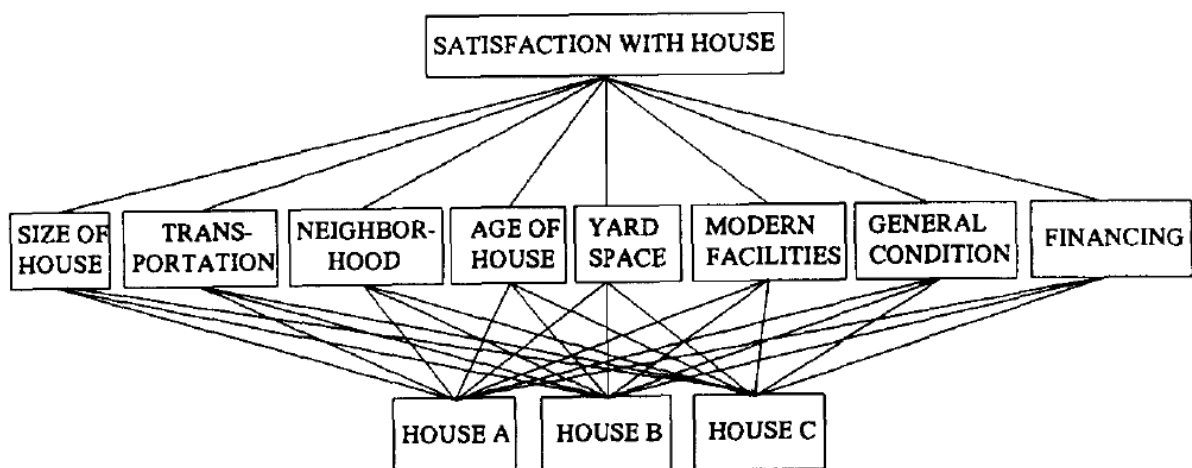


Figure 9 Example of a hierarchy model (Saaty, 1990)

A hierarchy does not need to be complete, that is, a criterion in a given level does not have to function as a criterion for all the elements in the level below. A hierarchy is not the traditional decision tree but each level may represent a different cut of the problem (Saaty, 1990).

5.2.2 Pair-wise comparisons

Pair-wise comparisons of the (sub) criteria are made in terms of importance, which represents in this research their share in the choice of a tenant to participate or not, according to the project managers. When comparing a pair of (sub) criteria, a ratio of relative importance of the factors can be established. This ratio need not to be based on some standard scale such as feet or meters but represents the relationship of two factors being compared. In AHP a verbal scale to enter judgments is used. (Saaty, 1990; Adamscek, 2008).

In this research, 5 levels of importance were presented, namely 1, 3, 5, 7 and 9. 1 means that both criteria are relatively equaled important and 7 means that a criterion A is very much more important than criterion B. According to the reciprocity of the relative importance, if criterion A is absolutely more important than attribute B and is valued 9, then B must be absolutely less important than A and is valued 1/9.

Table 6 Levels of importance with the associated scale

	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> A A is absolutely more important than B A is very much more important than B A is much more important than B A is somewhat more important than B A and B are equal important </div> <div style="text-align: center;"> B B is somewhat more important than A B is much more important than A B is very much more important than A B is absolutely more important than A </div> </div>								
	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">←</div> <div>Importance</div> <div style="text-align: center;">→</div> </div>								
Importance scale	9	7	5	3	1	3	5	7	9
Value	9	7	5	3	1	1/3	1/5	1/7	1/9

5.2.3 Pair-wise matrix evaluation

During the pair-wise comparison, every criterion is compared to the other criteria of the same level with respect to the element in the higher level by using the importance scale. For this research this means that there are 5 groups of (sub) criteria which are compared with each other. The first are the criteria with respect to the goal, and the other four are the sub criteria with respect to the criteria. As an example, three criteria are pair-wise compared in the following way: A is absolutely more important than B, A is somewhat more important than C and C is somewhat more important than B.

Table 7 expresses these relations of importance.

Table 7 Example of a pair-wise comparison

	9	7	5	3	1	3	5	7	9	
A	X									B
A				X						C
B						X				C

This group of criteria should then be expressed in a matrix like Table 8. This is shown in an abstract way in Figure 10.

Table 8 Example of a Reciprocal Matrix

	A	B	C
A	1	9	3
B	1/9	1	1/3
C	1/3	3	1

$$\begin{matrix}
 & A_1 & A_2 & \dots & A_n \\
 \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_n \end{matrix} & \begin{pmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \\ \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{pmatrix}
 \end{matrix}$$

Figure 10 Example of a Reciprocal Matrix by Saaty (1990)

This matrix is called a Reciprocal Matrix. This is because only the white boxes are filled in with the values of the pair-wise comparison. The dark grey boxes are then calculated by taking the opposite value by dividing 1 with the value of the opposite related box. For example, is box AB=9, then box BA=1/9. Note that boxes in which the same criterion comes together, the value is always 1.

This Reciprocal Matrix will be used to further calculate the relative importance of each criterion. According to Saaty et.al. (1984) there are three methods to derive estimates of ratio scales from a reciprocal matrix: the Eigenvalue, Logarithmic Least Squares, and Least Squares methods. In this research is chosen for the Eigenvalue method. This choice is based on the fact that it is likely that the data contains inconsistent matrices, due to an inconsistent filling of the comparison tables (see section 5.2.4 about inconsistency). Saaty et.al. (1984) stated that “the eigenvector method is a useful method for addressing the problem of inconsistency. In fact it is the only method that should be used when the data are not entirely consistent in order to make the best choice of alternative” (Saaty et al, 1984).

According to the eigenvector method, to find the eigenvector of every criterion the matrix has to be ‘squared’. This means that the matrix has to be multiplied by itself to find the principal Eigenvalue (EV) of a criterion. This is done by multiplying the first box of the vertical column and the first box of the horizontal row of the matrix, plus the second box of the column multiplied by the second box of the row, etcetera. In the boxes of Table 9 the corresponding equations are shown.

Table 9 Squaring the Reciprocal Matrix

	A	B	C
A	(AA*AA)+(BB*BB)+(CC*CC)	(AA*AB)+(AB*BB)+(AC*CB)	(AA*AC)+(AB*BC)+(AC*CC)
B	(AA*BA)+(BA*BB)+(CA*BC)	(BA*AB)+(BB*BB)+(CB*BC)	(BA*BC)+(BB*BC)+(BC*CC)
C	(AA*CA)+(BA*CB)+(CA*CC)	(CA*AB)+(CB*BB)+(CC*CB)	(CA*AC)+(CB*BC)+(CC*CC)

The Eigenvalues are calculated by summing the values in every box of the same row (Adamcsek, 2008). Based on Saaty (1990) and Figure 10, the calculation of the squaring and subsequently the Eigenvalue can also be expressed in the following equation:

$$EV = (W1, W2, \dots, Wn)^n$$

Equation 1 Calculating the Eigenvalue of a row

When the Eigenvalues of every criterion are derived, the last step to find the relative importance is normalizing the Eigenvalues. The Normalized Eigenvalues (NEV) are found by dividing every Eigenvalue by the total of Eigenvalues within the matrix. The matrix from Table 10 will be used as an example to illustrate the deriving of the Eigenvalue and normalized Eigenvalue.

Table 10 Example of the calculation of the Eigenvalue (EV) and the Normalized Eigenvalue (NEV)

	A	B	C	EV	NEV
A	3	27	9	39	0,69
B	0,33	3	1	4,33	0,08
C	1	9	3	13	0,23
Total				56,33	1

5.2.3.1 Complex matrix evaluation

When the relative importance of more than one respondent has to be calculated, the values within the reciprocal matrix should represent the combined value of all the values of all the matrices. Therefore, the weighted geometric mean method will be used. This method is the most common group preference aggregation method in the AHP literature (Adamscek, 2008). In this method, all the values are combined in order to form one matrix consisting of the composed values of all the individual respondents; this is called the Complex Matrix.

The geometric mean is type of average, which indicated the mean value of a set of numbers by using the product of their values. Because of the fact that the numerical difference between 1 and 9 is different than between 1 and 1/9 while the importance scale is the same, it is not possible to calculate with the average of the values. The boxes of the Complex Matrix are filled by taking the geometric mean of the values derived from the pair-wise comparisons of all the respondents. The calculation of the EV and NEV is the comparable to the calculation for a Reciprocal Matrix.

5.2.4 Consistency analysis

An important stage for calculating the relative importance of the criteria is to check the data on the consistency of the matrices. This must be done for every reciprocal matrix separately. The Consistency Ratio (CR) measures how consistent the judgments (filled in values) have been relative to large samples of purely random judgments. If the CR is much larger than 0.1 (10%) the judgments are untrustworthy because they are too close to randomness (Adamscek, 2008).

In order to find the Consistency Ratio first the Consistency Index should be found, which is defined by Saaty (1990) as:

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

Equation 2 Consistency index

The λ_{\max} is the sum of the λ for every criterion. The λ is the sum of the values in a column for a single criterion, multiplied by the Normalized Eigenvalue. The n is the number of different (sub) criteria which are compared within a matrix. It can be imagined that this λ should be close to 1 and that a matrix is absolute consistent when $\lambda_{\max} = n$, in which n is the number of criteria within the matrix.

To derive a meaningful interpretation of the Consistency Index, Saaty simulated random pair-wise comparisons for different size matrices, and arriving at an average consistency index for random judgments for each size matrix (Adamscek, 2008). In the table below the upper row is the number of criteria of the random matrix, and the lower is the corresponding index of consistency for random judgments. Note that for this research the number of criteria is 3 or 4 so the numbers 0.58 and 0.90 are used as random index.

Table 11 Random Consistency Index

<i>n</i>	2	3	4	5	6	7	8	9
Random CI	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

The Consistency Ratio is defined as the ratio of the Consistency Index for a matrix, to the average Consistency Index for random comparisons for a matrix with the same n .

$$CR = \frac{CI}{\text{random CI}}$$

Equation 3 Consistency Ratio

Below, the CI and CR are calculated. Note that this matrix is perfectly consistent. This can also be argued with logic. When A is 9 times more important than B, and A is 3 times more important than C, it is logical that the relation between B and C is that C is 3 times more important than B.

Table 12 Calculation of the Consistency Index and Consistency Ratio

	A	B	C		CI
A	1	9	3		0
B	0.11	1	0.33		Random CI
C	0.33	3	1		0.58
Total	1.44	13	4.33		CR
λ	1	1	1	$\lambda_{\max} = 3$	0

5.2.4.1 Complex matrix consistency

By calculating the relative importance of all the matrices, the matrices were combined in one matrix called the Complex Matrix. This Complex Matrix should also be tested on its

consistency. The calculation of the consistency is comparable to the calculation for a Reciprocal Matrix. The EV and NEV are derived from the Complex Matrix and the consistency is calculated by using Equation 3.

5.2.4.2 Respondent and group consistency

Besides the consistency of every matrix separate and the consistency of the Complex Matrix, it is also possible to calculate the overall consistency of all the matrices of one respondent. This can be done by taking the sum of the CI of all the matrices and divide this by the sum of the random CI of the matrices (Saaty, 1987). This is represented in Equation 4, in which M stands for the respondents matrices.

$$\text{Respondent CR} = \frac{\sum_{M=1}^n CI}{\sum_{M=1}^n \text{Random CI}}$$

Equation 4 Calculation of the respondent consistency

When the consistency of the group has to be calculated, sum of the CI of the respondents of the specific groups is divided by the sum of the random CI of the respondents in this specific group. This is shown in Equation 5 in which the R stands for the respondent.

$$\text{Group CR} = \frac{\sum_{R=1}^n CI}{\sum_{R=1}^n \text{Random CI}}$$

Equation 5 Calculation of the group consistency

5.2.5 Choosing the best alternative

As mentioned in the introduction of chapter 5, the ranking of the alternatives is done by multiplying the criteria specific idealized or normalized weight of the alternatives with the corresponding relative importance of the criteria and summing up the results to obtain the final composition of the alternatives' priorities with respect to the goal. In the previous sections in explained how the relative importance of the (sub) criteria can be calculated. Now it is important to determine the criteria specific weight. This process is further explained in chapter 6.

5.3 Data implementation

In this section the application of the method to this research will be discussed. The same steps (designing the hierarchy model, processing the data of the pair-wise comparisons and checking the consistency) will be followed as explained in the first half of this chapter.

5.3.1 Hierarchy model

Because the outcomes of the survey have to be comparable to the results from the literature study, the hierarchy model is based on Figure 8, the preliminary statement. In Figure 11 the hierarchy model is shown and represents the most important project decisions which have an influence on the tenant participation. For the readability, the hierarchy model is rotated so that the upper layer, the goal, is placed on the left side. Because the alternatives in this study are case studies and will be elaborated in the next chapter, they are not yet included in the hierarchy model.

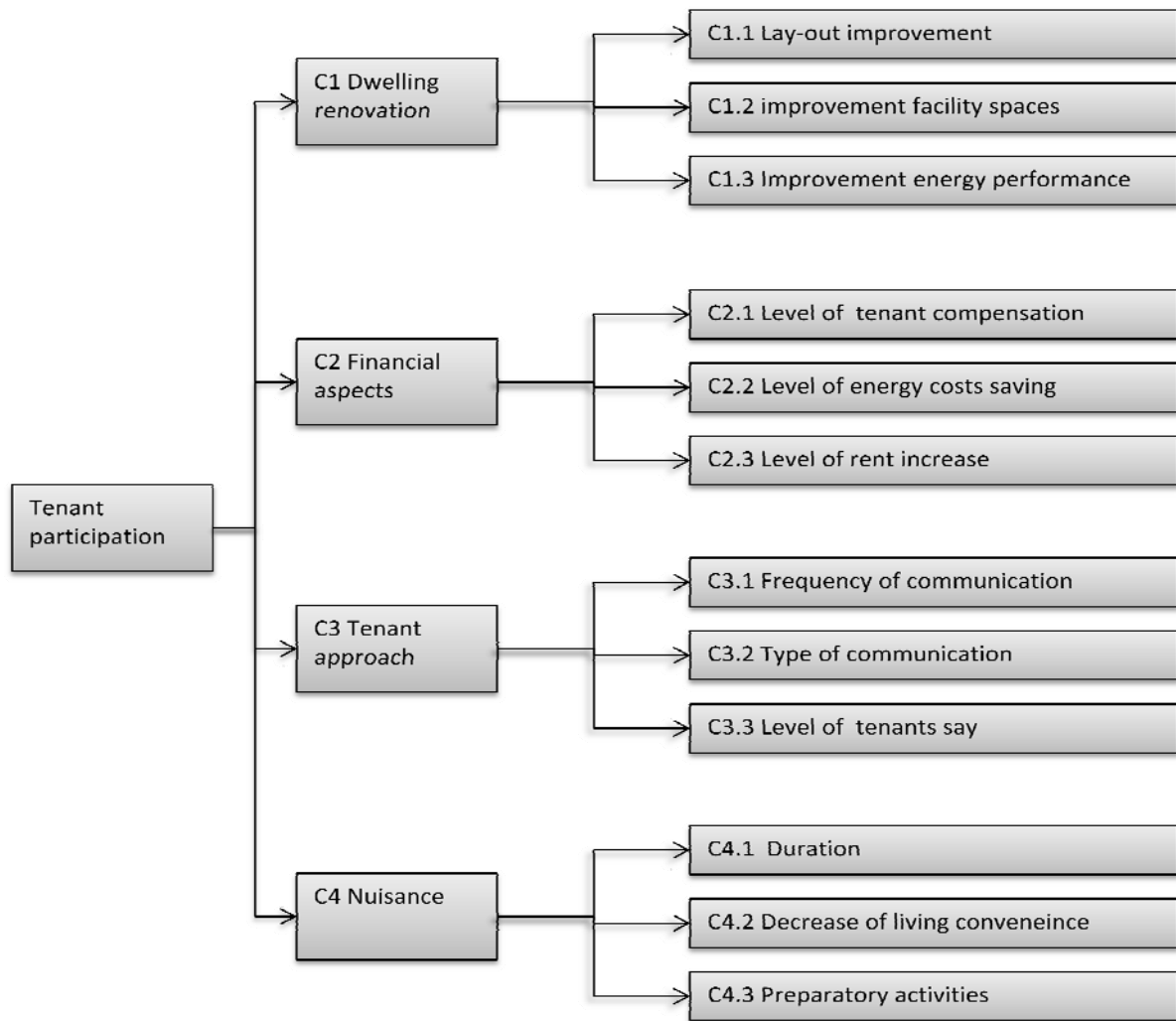


Figure 11 Hierarchy model

In Table 13, the description and the type of influence is shown. A positive influence means that a 'high' score on this criterion has a participation increasing influence. A negative influence means that a 'high' score on this criterion decreases the participation rate.

Table 13 Description of the criteria

Criteria	Description	Influence
C1 Dwelling renovation		
C1.1 lay-out improvement	The reconfiguration of the floor plan and/or expansion of living space	Positive
C1.2 improvement facility spaces	The possibility to renovate the kitchen and/or bathroom and/or toilet	Positive
C1.3 improvement energy performance	The improvement of the energy performance of the dwelling expressed in the energy index	Positive
C2 Financial aspects		
C2.1 level of tenant compensation	The number of Euros a tenants gets as compensation for the nuisance/participation	Positive
C2.2 level of energy costs saving	The number of Euros the energy bill of the tenant is expected to decrease	Positive
C2.3 level of rent increase	The number of Euros the rent increases after the project is applied	Negative
C3 Tenant approach		

C3.1 frequency of communication	The number of communication moments	Positive
C3.2 type of communication	The type of the communication in which the impact of the type is determined by the experts.	Positive
C3.3 level of tenants say	The extent to which tenant have a say in the project	Positive
C4 Nuisance		
C4.1 duration	The number of days the project takes per house	Negative
C4.2 decrease living convenience	The decrease of possibilities to wash and/or cook and/or sleep, up to temporarily moving	Negative
C4.3 preparatory activities	The activities the tenant has to do before the renovation. For example moving furniture	Negative

5.3.2 Respondent characteristics

To get data on the relative importance of the criteria with respect to the tenant participation, a survey was conducted among a focus group of project managers of sustainable renovation projects. Via Atrienis a list of 125 persons was composed with the appropriate job description within Dutch housing associations. The survey was designed in a digital format provided by the DDSS department of the TU/e and the link was emailed to these respondents. The respondents were asked to fill in the experience they have with sustainable renovation project, to make sure they can be seen as an expert focus group.

In the period from June 19th up till July 3th (2 weeks) 36 respondents filled in the survey. This means that a respondent rate of 29% was gained. The experience of the respondents with sustainable renovation lay between the 2 and 15 year with one peak on 25 year. The average year of experience was over 6.08 year.

The respondents had the possibility to fill in their email addresses at the end of the survey. 26 of the 36 respondents (72%) filled in their email address and all the email addresses contained the name of the housing association the project manager works for. Although it was not planned during the design of the survey, this information was used to further divide the group of respondents. This is further explained in section 5.3.6.

5.3.3 Survey design

The survey started with an introduction and subsequently an explanation of the survey. Hereafter the definition of the criteria was given. These definitions were also added below the tables they had to fill in so that the respondents did not have to get back in the pages to find the meaning of the criteria.

The questions asked to the respondents in the questionnaire were constructed as follows:

For the criteria:

“Compare the influence of the ‘criterion’ with respect to tenant participation, which criterion is of more interest, according to you?”

For the sub criteria:




























“Compare the influence of the ‘sub criterion’ with respect to ‘criterion higher level’, which criterion is of more interest, according to you?”

Then, a table was shown in which the respondent could fill in their answers (Table 14 is an example). In the survey, underneath each table was an explanation of the showed criteria given. An explanation

of the survey and the definitions of the (sub) criteria were also given at the beginning of the survey. The total survey is shown in Appendices

Appendix 1.

Table 14 Example of a table of the survey

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Verbetering plattegrond										Verbetering facilitaire ruimtes
Verbetering plattegrond										Verbetering energieprestatie
Verbetering facilitaire ruimtes										Verbetering energieprestatie

5.3.4 Data quality

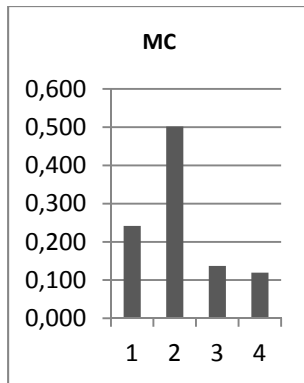
The quality of the data was determined by calculating the consistency. For the main results (all the respondents together) this was done for both the individual matrices as the total consistency of the respondents (see section 5.3.4). In the processing of the data a consistency ratio below 0.10 (10%) for the individual matrices, and a consistency ratio below 0.15 (15%) for the respondents was accepted. This led to the exclusions of 14 respondents (39%) and 45 inconsistent matrices from consistent respondents. For the analysis of different groups only the respondent consistency was taken into account, which means that only the inconsistent respondents were excluded.

5.3.5 Main results

The relative importance of every criterion was calculated on the basis of the steps of the AHP mentioned in section 6.2. In Table 15 the Normalized Eigenvalue, in other words the relative importance of the (sub) criteria is shown per criteria group.

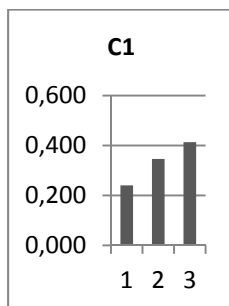
Table 15 Normalized Eigenvalue

	MC	C1	C2	C3	C4
1	0,242	0,240	0,186	0,169	0,506
2	0,502	0,347	0,217	0,394	0,280
3	0,137	0,413	0,597	0,437	0,214
4	0,119				
Total	1	1	1	1	1



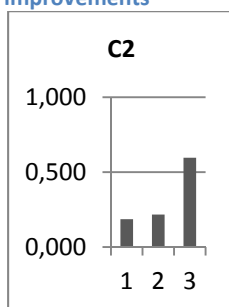
Graph 1 Main criteria

The division of the main criteria (MC) is as follows: 1 stands for the dwelling improvements, 2 for the financial aspects, 3 for the tenant approach and 4 for the nuisance. With a value of 0.502 the financial aspects are the most important according to the project managers. The difference of the importance of the financial aspects and the other criteria is relatively large compared to the difference between the other criteria mutually (see Graph 1). The second important criterion is the dwelling improvement with a value 0.242. Tenant approach and nuisance are the third and fourth criteria with a value of respectively 0.137 and 0.119.



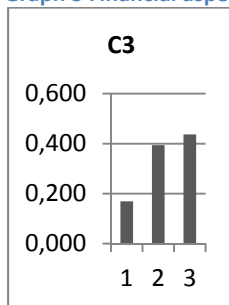
Graph 2 Dwelling improvements

When it comes to sub criteria 1, the dwelling improvement, C1.3 (improvement of the energy performance) is the most important according to the project developers, with a value of 0.413. C1.2 (improvement facility spaces) is second with a value of 0.347 and the least important is C1.1 (lay-out improvement) with a value of 0.240.



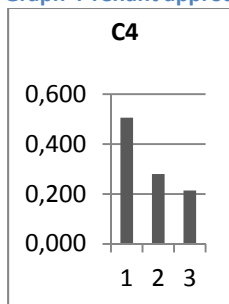
Graph 3 Financial aspects

When it comes to sub criteria 2, the financial aspects, C2.3 (level of rent increase) is by far the most important according to the project managers, with a value of 0.597. Criteria C2.2 (level of energy costs saving) and C2.1 (level of tenant compensation) are less important with a value of 0.217 and 0.186.



Graph 4 Tenant approach

When it comes to sub criteria 3, the tenant approach, C3.3 (level of tenants say) and C3.2 (type of communication) are the most important by the project managers with a value of 0.437 and 0.394. C3.1 (frequency of communication) is less important with a value of 0.169.



Graph 5 Nuisance

When it comes to sub criteria 4, the nuisance, the duration of the work (C4.1) is the most important with a value of 0.506. According to the project managers C4.2 (decrease of living convenience) has a relative importance of 0.280 and C4.3 (preparatory actions) has relative importance of 0.214.

After the calculation of the relative importance per matrix, the main criteria and sub criteria are combined to calculate the relative importance with respect to the goal, tenant participation. This is done by multiplying the relative importance of the sub criteria with the relative importance of the criteria in the higher level. The results are presented in Table 16.

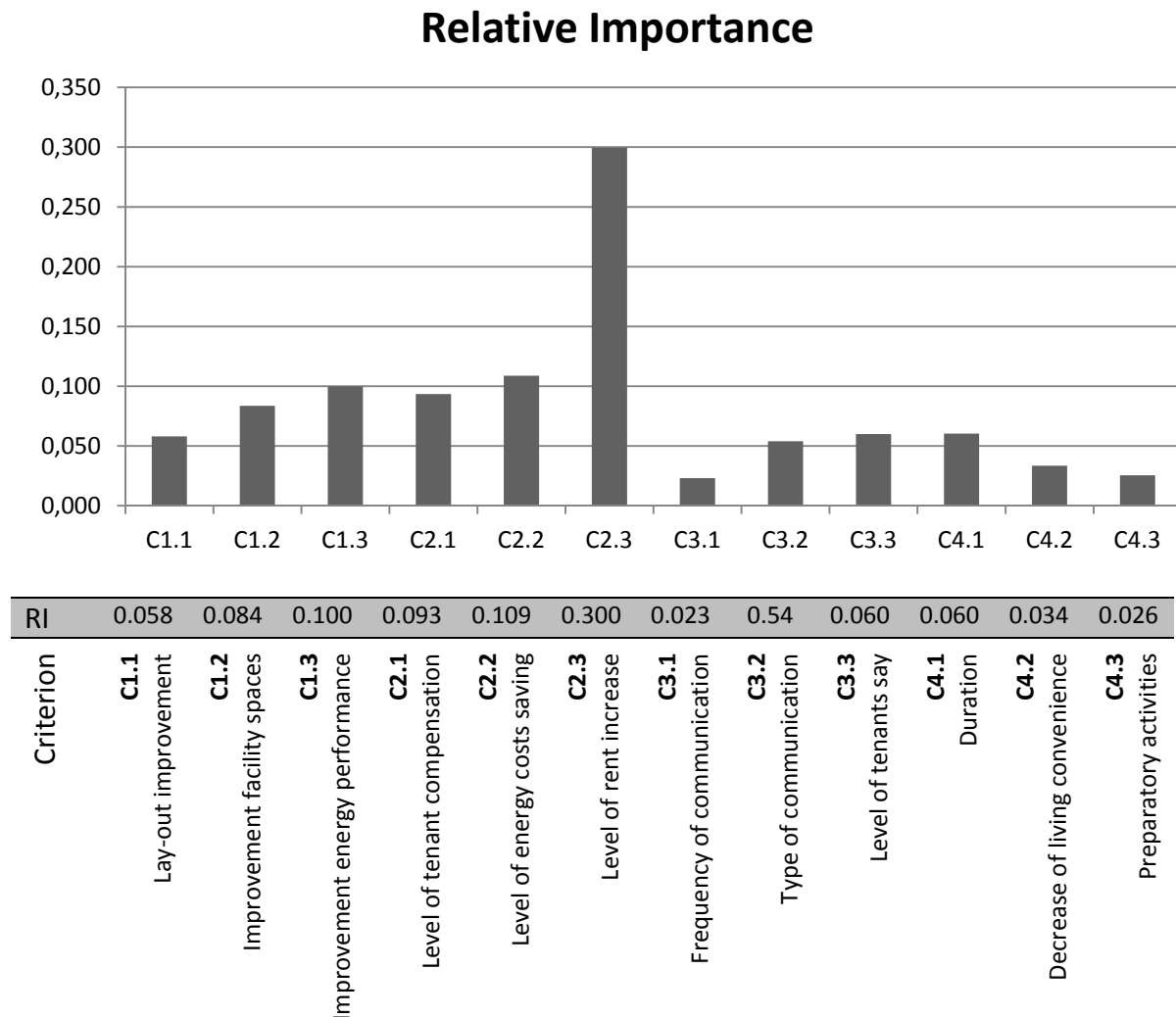


Table 16 Calculated relative importance of the sub criteria

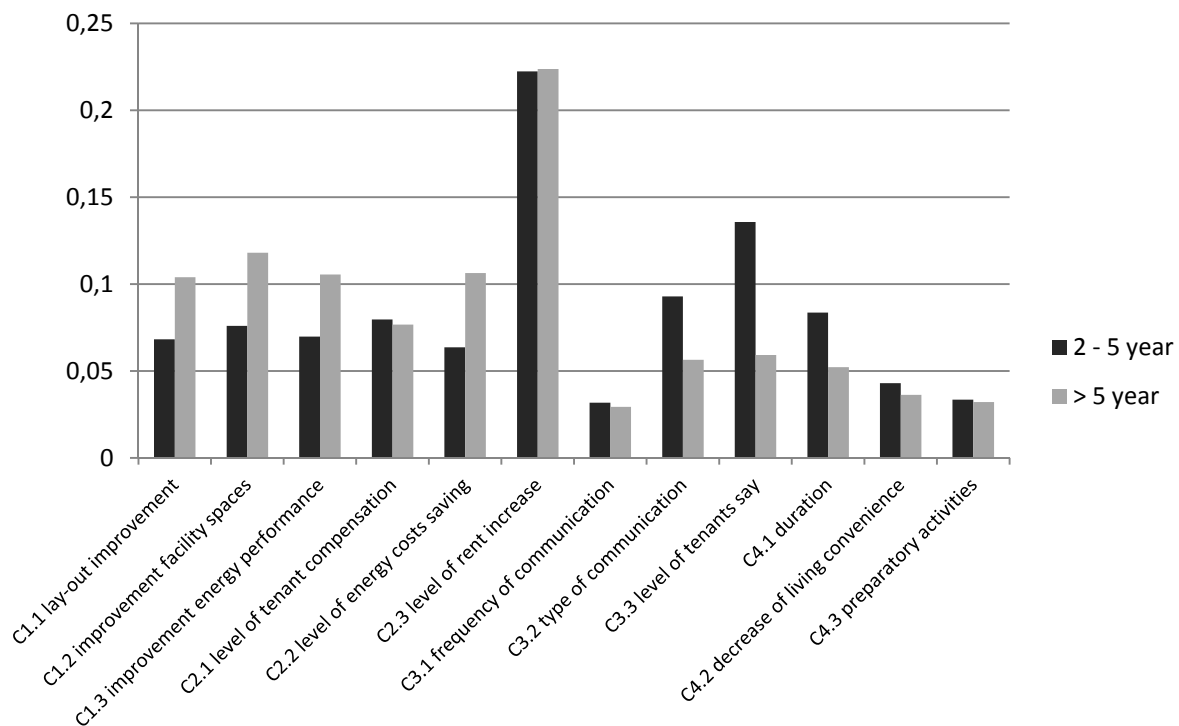
Table 16 shows that C2.3 (level of rent increase) is by far seen as the criterion with the biggest influence on the tenant participation according to the project managers. In this figure, the division of the importance between the main criteria is still visible. Generally, C1 (dwelling renovation) and C2 (financial aspects) are seen to be more important than C3 (tenant approach) and C4 (nuisance).

5.3.6 Group results

When analyzing the data, it was noticed that the relative importance of the different respondents mutually differ to a great extent. This observation leads to an analysis of the data to find divisions in the respondents group which can explain the apparent randomness of the preferences of the respondents. Besides their preferences, the only other questions asked to the respondents were their years of experience, and their email addresses. On the basis of their email addresses it was possible to link the respondents to a certain housing association. See Appendix 2 for the division per respondent.

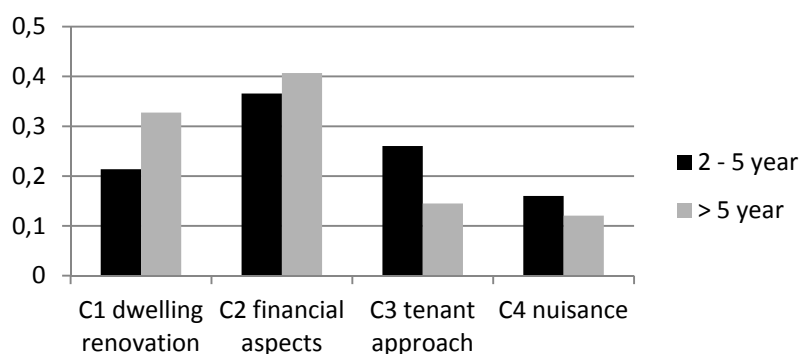
5.3.6.1 Division by experience

The first division was by dividing the group in the most experienced and the less experienced respondent. Therefore the respondents were divided into two groups, project managers with 2 – 5 year experience (none of the respondents had less than 2 year experience) and project managers with more than 5 year experience. The division is made by 5 year because half of the respondent has more and half has less experience. A respondent consistency ratio of 0.15 (15%) is maintained. The group consisting of project managers with 2 – 5 year experience consisted of 11 respondents and had a group consistency of 0.095 (9.5%). The group consisting of project managers with more than 5 year experience consisted of 12 respondents and had a group consistency of 0.082 (8.2%). The outcome is shown in Graph 6.



Graph 6 Relative importance per group, divided by experience

Graph 6 shows that projects managers with more than 5 year experience, consider C1.1 (lay-out improvement), C1.2 (improvement of facility spaces), C1.3 (improvement of the energy performance), and C2.2 (decrease of energy costs) to be more important than project managers with 2 - 5 year experience. On the other hand project managers with more than 5 year experience consider C3.2 (type of communication moment), C3.3 (level of tenants say), and C4.1 (duration) to be less important than project managers with 2 - 5 year experience. These differences are mainly due to the difference of preferences in the main criteria, see Graph 7.



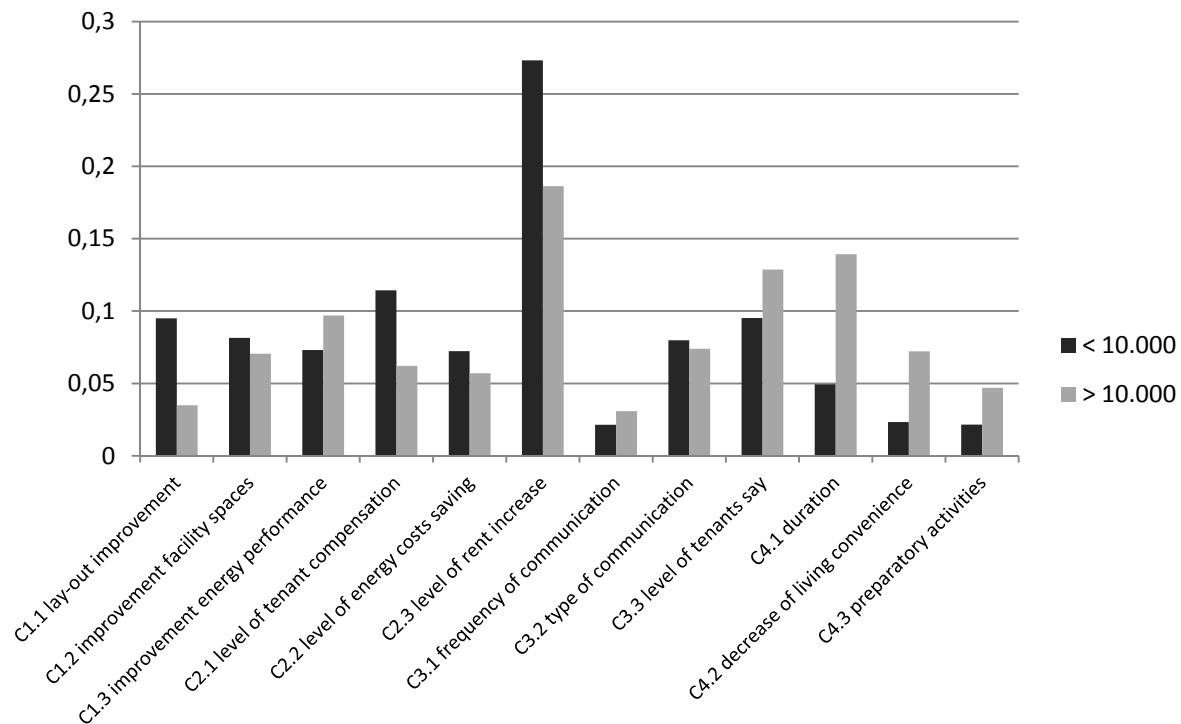
Graph 7 Relative importance main criteria, divided by experience

Project managers with more than 5 year experience consider C1 (dwelling improvements) to be more important and C3 (tenant approach) to be less important than project managers with 2 – 5 year experience.

An explanation for this difference could be that project managers with less experience are also younger persons who work at the housing association for a shorter period. In general are older persons somewhat more traditional and have a different way of approaching projects than younger persons. In conversation with an expert at Atriensis was confirmed that within the sustainable renovation projects new insights are gained about involving tenants and the tenant approach is seen as more and more important. This could explain the differences shown in Graph 7. The emphasis on the dwelling renovation by project managers with more than 5 year experience could also be the effect of the shifting in focus between 'older' and 'younger' project managers.

5.3.6.2 Division by housing association size

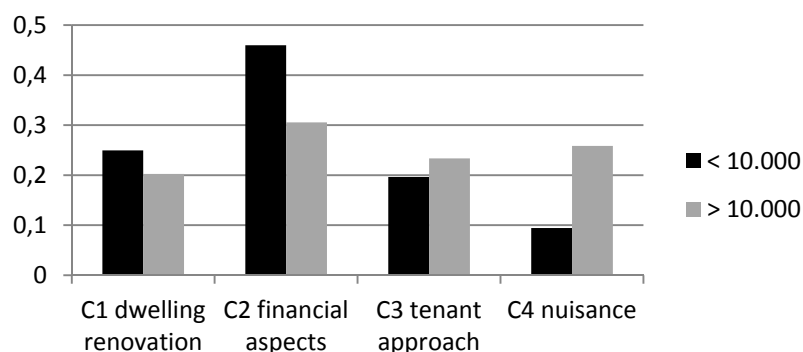
The next division was done on the basis of the size of the housing association. The division was made between respondents related to housing associations with more than 10.000 housing units and respondents related to housing associations with less than 10.000 housing units. A respondent consistency ratio of 0.15 (15%) was maintained. Also the respondents of which the corresponding housing association was unknown were excluded. The group of project managers from housing associations with less than 10.00 housing units consists of 10 respondents with a group consistency of 0.093 (9.3%). The other group coming from housing associations with more than 10.000 housing units consists of 7 respondents with a group consistency of 0.080 (8.0 %).



Graph 8 Relative importance per group, divided by the size of the stock

Graph 8 shows that project managers from housing association with less than 10.000 rental units consider C1.1 (lay-out improvement), C2.1 (inconvenience fee) and C2.3 (level of rent increase) to be more important than project managers from housing associations with more than 10.000 rental units. The opinions of the project managers also differ. This difference is the most with C4, the duration (C4.1), decrease of living convenience (C4.2), and preparatory actions (C4.3) are considered to be more important by project managers from housing associations with more than 10.000 dwellings.

Also in this division the main difference is due to the difference in preference of the main criteria. Mostly the difference is shown in the preference of C2 (financial aspects) and C4 (nuisance). See Graph 9.



Graph 9 Relative importance main criteria, divided by the size of the stock

A possible explanation for the difference in focus is that project managers have projected their own focus on the possible focus of the tenants. It is thinkable that a smaller housing association puts more focus on the financial aspects because they have a lesser budget or

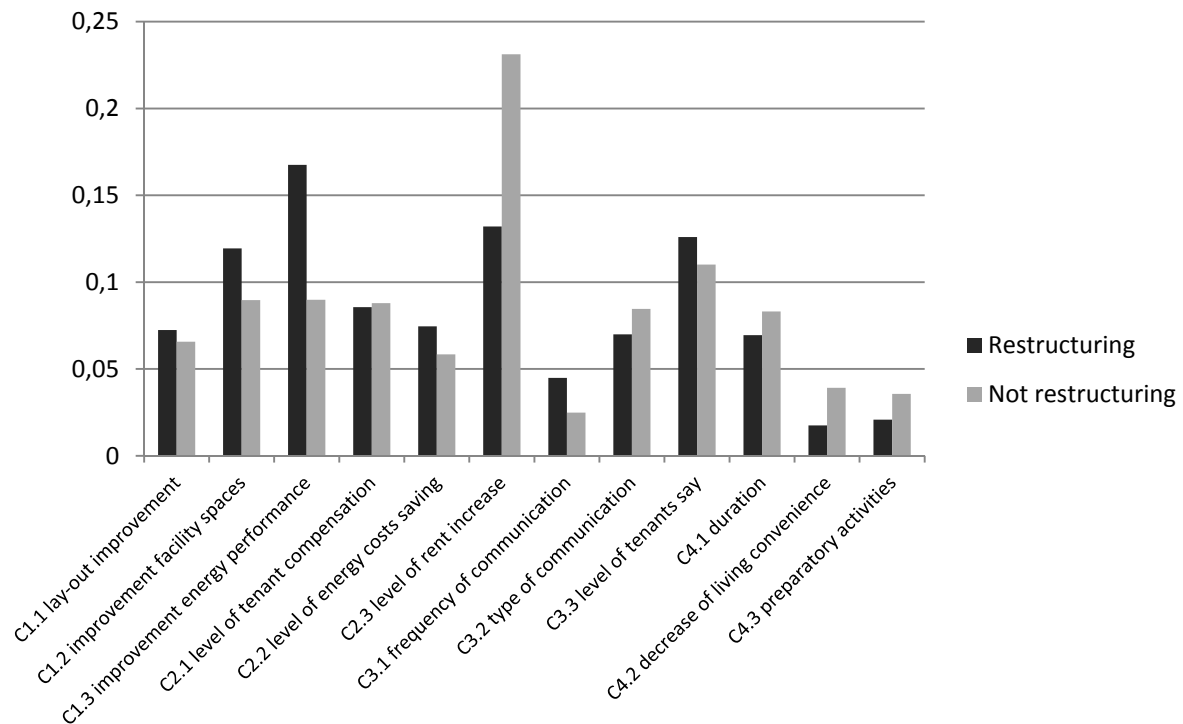
less liquidity. Because C2 (financial aspects) is then important on the establishment of the project plan, the project managers think this is also of great importance for the tenants in their decision to participate or not. A possible explanation for the greater importance of C4 (nuisance) for bigger housing associations is that they have more possibility to help the tenants to lower the nuisance. Because they apply more limitation of nuisance, they think this aspect is more important or they have experienced the effect of the limitation of nuisance.

Smaller housing associations have fewer employees than larger housing associations. Larger housing associations have more departments with more knowledge than smaller housing association. This has the effect that a project manager from a large housing association has more specific responsibilities, and project managers from smaller housing associations have more broad or combined responsibilities. By having more knowledge and capacity, it is possible that the vision of project managers from large housing associations differ from the vision of project managers from smaller housing associations.

5.3.6.3 Division by restructuring activities

The last division was made in associations which are known as restructuring associations and associations which are not known as restructuring associations. This is done on the basis of the division from the CFV. The CFV (Central Fund for Housing; Dutch: Centraal Fonds Volkshuisvesting) publishes an annual report in which they distinguish associations into reference groups. Associations which are actively restructuring are characterized by expenditures on renovation and home improvement which are about twice the average expenditures of housing associations (€ 32.851 per dwelling for big restructuring associations against € 17.473 per dwelling average) (see Appendix 3) However, the difficulty was that four of the six respondents from reconstructing housing associations did not meet the sufficient consistency of 0.15 (15%). When a consistency ration of 0.25 (25%) was maintained, the data from the project leaders could be taken into account. So, it is important to keep in mind that the data shown in Graph 10 are less consistent than the rest of the data. The respondents of which the restructuring activities of the housing association were unknown were also excluded.

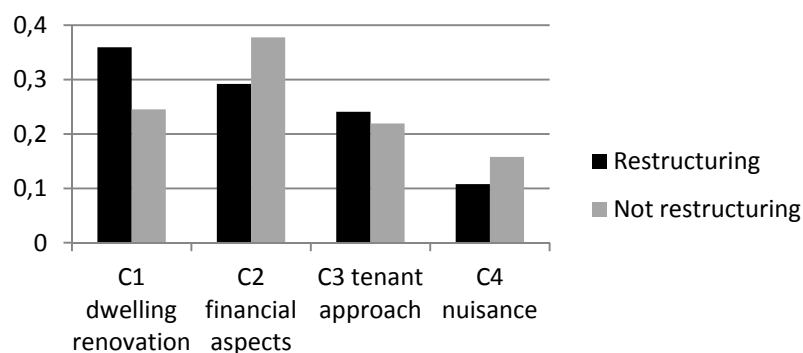
The group of project managers from housing associations that are actively restructuring consists of 6 respondents with a group consistency of 0.155 (15.5%). The other group consists of 17 respondents with a group consistency of 0.108 (10.8%).



Graph 10 Relative importance per group, divided by the restructuring activities

Graph 10 shows that project managers from restructuring housing associations believe that C1.3 (improvement of the energy performance), the other aspects of C1 (lay-out improvement and improvement facility spaces), and C3.3 (level of tenants say) are more important compared to the opinion of project managers from not restructuring housing associations. On the other hand, C2.3 (level of rent increase), C4.2 (decrease of living convenience), and C4.3 (preparatory actions) are considered to be less important by project managers from restructuring housing associations.

Also in the division by restructuring activities, the differences can be mainly attributed to the differences in preference of the main criteria. In Graph 11 is shown that project managers from housing associations with large restructuring activities state that C1 (aspects of the dwelling renovation) are the most important of the main criteria, while the rest of the project managers think that C2 (financial aspects) are the most important.



Graph 11 Relative importance main criteria, divided by the restructuring activities

This difference can be explained by the fact that restructuring housing associations invest more in renovation activities. Therefore it is likely that they apply more innovative improvements because they have more financial sources to take risks with these innovative improvements than non-restructuring housing associations. This can explain why the emphasis for restructuring housing associations is more on the aspects of the dwelling improvement than on the financial aspects.

5.4 Conclusion

In this section the relative importance of the influence of parts from the project plan on the tenant participation was derived according to the project managers. To do this, steps belonging to the AHP method were used. To get the opinion from the project managers a survey was distributed to project managers from different Dutch housing associations to give answer to the following research question:

“What is the effect of the project plan on the tenant participation according to the project managers?”

According to the project managers, the financial factors are the most important aspects that influence the tenant participation. Thereof, the level of rent increase is the most important criteria. Next, the aspects of the dwelling renovation are considered to be important, with the improvement of the energy performance as most influential sub criteria. The tenant approach and the nuisance are considered to be less important. The most important sub criteria of those two criteria were the level of tenants say, the type of communication and the duration.

Striking was that there was a large diversity between the answers of the respondents. Therefore was tried to divide the respondents group into different groups and analyze the differences in outcome. The respondents group was divided on the basis of experience and characteristics of the housing association the project manager works for: number of housing stock units and restructuring activities of the housing association. The relative importance differed in all different divisions.

This difference in the three divisions led to two possible conclusions. The first is that there is a difference in the approach of ‘older’ and ‘younger’ project managers and the younger project managers focus more on the tenant approach. ‘Older’ and ‘younger’ is determined on the basis of experience years in which 2 – 5 year experience is ‘younger’ and ‘older’ is more than 5 year experience. The second is that project managers are influenced by the characteristics of the housing association they work for. When a certain criterion is important for a housing association, the project managers think that this is also an issue for the tenant, because this is an important focus within the process of the establishment of the sustainable renovation project. This can be a low budget and little possibilities to limit nuisance for small housing associations. The research shows that housing associations with less than 10.000 housing units or with relatively less money for restructuring activities think the financial aspects are more important to the tenant than larger or actively restructuring housing association. Also restructuring housing associations think that tenant attach more importance to the dwelling improvements than housing associations with less restructuring activities. This is probably due to the fact that restructuring housing associations try more innovative and less conventional improvements causing the type of improvements to be more important.

6 The case alternatives

As mentioned at the beginning of this chapter, at the bottom of the hierarchy model lie the alternative options to approach a sustainable renovation project. In this research the alternatives are case studies which are abstracted to become suitable for application to AHP. By taking cases, it is also possible to evaluate the applicability of the statements of the project managers. By an analysis of the context afterwards, it is possible to give a statement about the ranking of the alternatives compared to the cases.

6.1 Determination of the weights

To be able to compare the alternatives with respect to the (sub) criteria, the output of every criterion should be determined expressed in the same unit for every case. This unit is called the weight of the criterion in the specific case (from now on referred to as 'weight'). The method to derive this weight is dependent on the output of the criterion. For example the translation of the 'level of rent increase' into a specific weight differs from the translation of the 'level of tenants say'.

The first step is to divide the output of the criteria into numerical or descriptive output. Numerical means that the output is expressed in a number, which can be Euros or the number of communication moments. Descriptive means that the output is expressed as a description. This output can be expressed in one word, for example 'excellent', or 'insufficient', or can be described into a phrase like 'the tenants had to move their furniture and cover their floor'. Table 17 shows the criteria and their output divided into numerical or descriptive output.

Table 17 Division of the criteria into descriptive and numerical

Criteria	Output	Division
C1 Dwelling renovation		
C1.1 lay-out improvement	Description	Descriptive
C1.2 improvement facility spaces	Description	Descriptive
C1.3 improvement energy performance	Energy label	Numerical
C2 Financial aspects		
C2.1 level of tenant compensation	Euros	Numerical
C2.2 level of energy costs saving	Euros	Numerical
C2.3 level of rent increase	Euros	Numerical
C3 Tenant approach		
C3.1 frequency of communication	Number	Numerical
C3.2 type of communication	Description	Descriptive
C3.3 level of tenants say	Description	Descriptive
C4 Nuisance		
C4.1 duration	Number of days	Numerical
C4.2 decrease living convenience	Description	Descriptive
C4.3 preparatory activities	Description	Descriptive

In the following sections will be described how both types of output will be further translated into a weight.

6.1.1 Numerical output

Numerical output can be linear related or non-linear related. This is visualized in Figure 12.

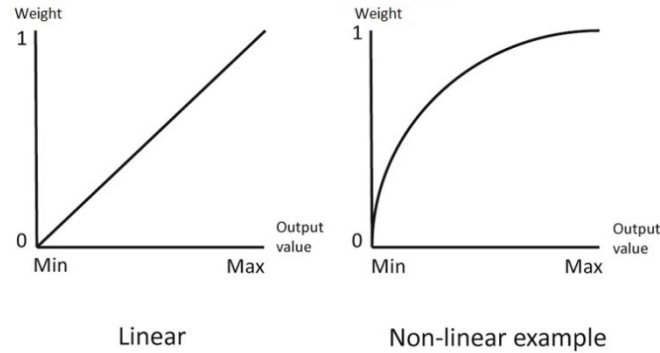


Figure 12 Example of a linear and non-linear relation

It is possible that the relation between the output value and the normalized value is not linear related. This is for example the case when the criterion is volume and the output unit is dB. Hereby an increase of the volume with 10dB means a decrease of the volume with a factor 10, so this is not a linear but a logarithmic scale relation. In this research, the relations between the output value and the weight of all the criteria are assumed to be linear.

The next step is to translate the output into the corresponding weight, because it must be possible to make an output of for example € 1.000 and € 5.000 (output of the ‘inconvenience fee’) comparable to ‘3 times’ and ‘4 times’ (output of the number of communication moments). This is done by translating the output into the form of an absolute scale of relative measures (Saaty, 2003). The scale is made relative in two ways: by *normalization* performed by dividing each output value by the sum of all output values or by *idealization* performed by dividing each value by the largest value among them. Idealization is used when the criteria are independent from the alternatives and also the alternatives are independent from the alternatives. Normalization is used when the criteria depend on the alternatives or when the alternatives depend on the alternatives (Saaty, 2003).

Because in this research five cases were taken as alternatives, the rating of the criteria in the cases is not dependent on the other cases. The tenant does not compare different cases with each other and then chooses one, but one case has a certain total weight, independent from the other cases. This is why in the determination of the weights *idealization* is used. This is shown in Equation 6.

$$Criteria\ weight = 0 \leq \frac{Output}{Largest\ output} \leq 1$$

Equation 6 Weight of a positive criterion

In this case the highest output will always get the weight 1. The output from other cases is calculated with respect to this highest output.

When the criterion is negative (see also Table 13) a slightly different approach should be applied. In a decision, one may have a criterion which contributes in a way that it increases tenant participation, and other alternatives contribute in a way that diminishes tenant participation. Because they are opposite in value a special way to combine the two is

necessary. Negative priorities can be derived from positive comparisons, except that the sense in which the question is asked in making the comparison is opposite to the sense used to derive positive numbers (Saaty, 2006).

It is also possible to give an opposite value to the criterion within the idealization, which ensures that the questioning is consistent for the whole survey. This is desirable for the clarity of the survey and to prevent inconsistent or ambiguous data. With an opposite normalized value a large output of the criteria in the alternative derives a low weight. In this case the largest outcome gets an idealized value of 0. The equation will thus be revised into:

$$Criteria\ weight = 0 \leq 1 - \frac{Output}{Largest\ output} \leq 1$$

Equation 7 Weight of a negative criterion

6.1.2 Descriptive output

When the output of a criterion is descriptive, the translation into weights is more complicated and requires other methods. The first step in this process is to create intensity levels or degrees of variation of quality on a criterion; for example excellent, above average, average, below average and poor. In this research, C1.1, C1.2, C3.2, C3.3, C4.2 and C4.3 have a descriptive output. In Table 18, the different levels for every criterion are shown.

Table 18 Different levels of the criteria

Criteria	Levels	Method
C1.1 lay-out improvement	None, little, average, high, maximum	Consultation of experts
C1.2 improvement facility spaces	None, little, average, high, maximum	Consultation of experts
C3.2 type of communication	None, little, average, high, maximum	Consultation of experts
C3.3 level of tenants say	None, little, average, high, maximum	Consultation of experts
C4.2 decrease living convenience	None, little, average, high, maximum	Consultation of experts
C4.3 preparatory activities	None, little, average, high, maximum	Consultation of experts

The expression of the descriptive criteria in the cases is done by classifying the criteria in levels from 'none' up to 'high'. The classification is verified by consulting several experts within Atrienis with experience in several sustainable renovation projects. An example of this classification is showed in Appendix 4.

6.2 Rating the cases

To calculate the total score of the alternatives, the alternatives have to be measured according to the overall goal, the tenant participation. This is done by summing the scores of all the criteria within one case (see Equation 8) (Saaty, 1990).

$$Total\ Score\ Case\ x = \sum_{Criteria=1}^n Criteria\ Score\ Case\ x$$

Equation 8 Total score

The score of one criterion in one case with respect to the goal is shown in Figure 13. This figure shows the hierarchy model including the cases at the bottom of the hierarchy. The thick line represents the score of C2.1 in case 3. The line in level 1 represents the relative importance of the criteria with respect to the goal, the line in level 2 represents the relative

importance of the sub criteria with respect to the criteria and the line in level 3 represents the weight of the sub criteria in the case.

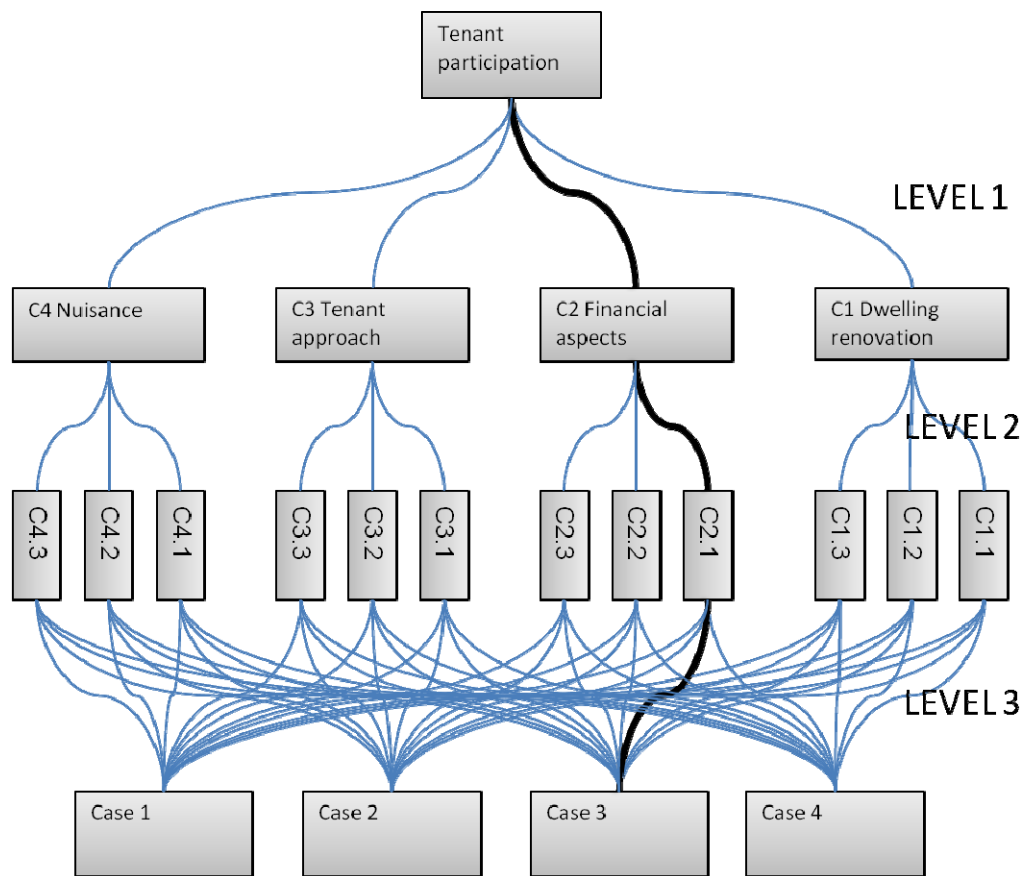


Figure 13 Representation of the criteria in the cases with respect to the goal

6.3 Case application

In this section a short description of the cases will be given followed by the weighting of the criteria within the cases. Subsequently the overall score of every case is calculated according to the method described in section 6.1 and section 6.2. Four cases are a selection of project in which Atriensis have had an advising role in advance or afterwards and were selected on the basis of available information and to have varying projects. One case is found via an external source.

6.3.1 Weights of the cases

First the content of the cases will be described, after that the weights of the criteria within the cases is calculated.

Case 1 is a building complex of 218 dwellings. All the dwellings are gallery apartments located in one building and divided over ten blocks. The sustainable measures which will be applied within this building complex are: floor insulation below the ground floor, substitution of the single glass, double glass and HR glass into HR++ glass inclusive the grids in the frames and the insulation of the ceilings and walls of the passageway. Before the

renovation the average energy label of the dwellings was E, this is improved to B after the renovation. The savings on the energy bill and the rent increase were calculated for separate for every dwelling. The average predicted savings on the energy bill were €12,- of which an average of €7,60 was passed to the rent. At the end 92% of the tenants participated.

Case 2 consists of 88 porch apartments and contains a large renovation with technical and energy saving improvements. The dwellings before the renovation have an average energy label E, after the renovation this will be improved to a label B for every dwelling. The improvements will be offered in exchange for a rental increase of € 18,50 a month. The improvements are: replacement of the window frames, placement of new insulating glass, insulation of the ceilings of the upper dwellings, insulation of the floors of the bottom dwellings, insulation of the façade, application of demand-controlled mechanical ventilation and the placement of a HR107 boiler. At the end 100% of the tenants participated.

Case 3 consists of 32 porch apartments and is the most extensive renovation of the four cases. The dwellings before the renovation have an average energy label E and after the renovation this will be improved to a label B for every dwelling. The improvements will be offered in exchange for a rental increase of € 18,50 a month. The improvements are: replacement of the window frames, placement of new insulating glass, insulation of the ceilings of the upper dwellings, insulation of the floors of the bottom dwellings, insulation of the façade, application of demand-controlled mechanical ventilation and the placement of a HR107 boiler. The renovation also consists of a lay-out improvement and noise reducing improvements. An extra rental increase of € 55,50- is calculated for this. The balcony will be enlarged and the warm tap water will be arranged through district heating. This all costs another rental increase of € 18,50 a month. At the end 100% of the tenants participated. The high participation can partly attributed to the fact that the tenants had complaints about the energy performance of their dwelling and were supporting the sustainable renovation project from the beginning.

Case 4 contains a gallery flat with 90 dwellings. The flat contains of 6 storeys with 15 dwellings on every floor. Every floor has 8 small and seven larger dwellings. The flat is built around 1972 and the average age of the tenants is high. Before the renovation, the average energy label for two third of the dwellings is E, the rest has the energy label F. The renovation plan consists of two parts which will be tendered separately. The first part is the insulation of the shell including the replacement of the glass into HR++ glass and ventilation grids. The floors above the ground floor and cavity walls with a low amount of insulation will be insulated. The second part contains improvements of the installations. The collective heat boilers will be replaced by gas absorbing heat pumps with a HR107 boilers as back up when the temperature outside is too low. Geysers and electric boilers will be removed and replaced by a collective water system with solar boilers and also an HR107 as back up. The small dwellings already have a mechanical ventilation system. In the new situation all the dwellings get a collective pressure controlled ventilation system with time control. At the end 83% of the tenants participated.

Case 5 contains 90 single-family dwellings with a building year around 1960. The sustainable renovation project consisted of improvements with the aim to increase the energy performance in combination with a paint job. This led to a label increase of 3 steps, from label F to label C. In some cases the wooden floor was renovated when there was fungus formation. A saving of € 21.25 on the energy bill was calculated and € 15.94 was passed to as

rent increase. At the end 23% participated. According to a policy employee of the housing association the first aim was to let at least 70% of the tenants participate. However, a group of tenants who did not want to participate influenced the other participants to also not to participate. This resulted in the low participation rate. A summary of the content of the cases is given in Table 19.

Table 19 Summary of the case content

Criteria	Case 1	Case 2	Case 3	Case 4	Case 5
C1 Dwelling renovation					
C1.1 lay-out improvement	none	none	different lay out kitchen; enlargement of balcony	none	none
C1.2 improvement facility spaces	none	none	kitchen improvement; district heating connection	none	none
C1.3 improvement energy performance	1 label step	3 label steps	3 label steps	2 label steps	3 label steps
C2 Financial aspects					
C2.1 level of tenant compensation	0	€ 1.300	€5.000	0	0
C2.2 level of energy costs saving	€ 12,- a month	€ 26,50 a month	€ 26,50 a month	€ 63,- a month	€ 21,25 a month
C2.3 level of rent increase	€ 7,60 a month	€ 18,50 a month	€ 92,50 a month	€ 33,47 a month	€ 15,94 a month
C3 Tenant approach					
C3.1 frequency of communication	5 times	4 times	4 times	5 times	4 times
C3.2 type of communication	Letters with survey; tenant committee; information day in a model dwelling; letter about paint color; individual house visits	Letter with survey; tenant committee; information day in a model dwelling; individual house visits	Letter with survey; tenant committee; information day in a model dwelling; individual house visits	Letter with survey; tenant committee; information evenings ; individual house visits; personal letter	Letter sent (no survey); information evening; model dwelling; telephone call to refusing tenants
C3.3 level of tenants say	residents committee with vote in the contracting; tenants had vote about the paint colors	consultation via survey and focus group	consultation via survey and focus group	Focus group has vote in the contracting	Minimal, only informing
C4 Nuisance					
C4.1 duration	3 days	20 days	40 days	4 days	5 days
C4.2 decrease living convenience	The tenants could stay, furniture had to be moved inside the house, floor covering	Tenants could stay, moving of large furniture, floor covering, gas/water/elec. before 7.30 AM and after 5.00 PM	Tenants had to temporarily move for 2 months. Other dwelling was offered.	Tenants could stay, 2 weeks no central heating, alternative electric heating offered.	Tenants could stay, most of the work was done on the outside.
C4.3 preparatory activities	Moving furniture indoors	Moving furniture outdoors and covering floors	Total moving out to a temporary dwelling	emptying storage; moving furniture indoors; covering floor	Moving furniture

To derive the weights of the criteria in the cases, idealization is used for the numerical values and consultation by experts is used to translate the descriptive output into a weight. The weights per criterion are shown in Table 20. In Appendix 4 is an example shown of how the rating of the descriptive criteria is done.

Table 20 Weights per criterion

Criteria	Case 1	Case 2	Case 3	Case 4	Case 5
C1 Dwelling renovation					
C1.1 lay-out improvement	0.00	0.00	1.00	0.00	0.00
C1.2 improvement facility spaces	0.00	0.00	1.00	0.00	0.00
C1.3 improvement energy performance	0.33	1.00	1.00	0.67	1.00
C2 Financial aspects					
C2.1 level of tenant compensation	0.00	0.26	1.00	0.00	0.00
C2.2 level of energy costs saving	0.19	0.42	0.42	1.00	0.34
C2.3 level of rent increase	0.92	0.80	0.00	0.64	0.83
C3 Tenant approach					
C3.1 frequency of communication	1.00	0.80	0.80	1.00	0.80
C3.2 type of communication	0.80	0.90	0.90	0.70	0.40
C3.3 level of tenants say	0.90	0.50	0.50	0.80	0.10
C4 Nuisance					
C4.1 duration	0.93	0.50	0.00	0.90	0.88
C4.2 decrease living convenience	0.40	0.30	0.10	0.30	0.40
C4.3 preparatory activities	0.50	0.30	0.00	0.20	0.50
TOTAL	5.96	5.78	6.72	6.21	5.24

6.3.2 Scores

To derive the scores, the weights have to be multiplied with the corresponding relative importance of that specific criterion, derived by the pair-wise comparisons in the survey, this result in the score of the criterion. By taking the sum of all the criteria, the total score of the case is calculated. The scores of the criteria and the cases are shown in Table 21. In Appendix 5 the total calculation of the scores is shown.

Table 21 Scores per criterion

Criteria	Case 1	Case 2	Case 3	Case 4	Case 5
C1 Dwelling renovation					
C1.1 lay-out improvement	0.0000	0.0000	0.0580	0.0000	0.0000
C1.2 improvement facility spaces	0.0000	0.0000	0.0837	0.0000	0.0000
C1.3 improvement energy performance	0.0329	0.0998	0.0998	0.0669	0.0998
C2 Financial aspects					
C2.1 level of tenant compensation	0.0000	0.0243	0.0935	0.0000	0.0000
C2.2 level of energy costs saving	0.0207	0.0458	0.0458	0.1088	0.0367
C2.3 level of rent increase	0.2749	0.2396	0.0000	0.1911	0.2479
C3 Tenant approach					
C3.1 frequency of communication	0.0232	0.0186	0.0186	0.0232	0.0186
C3.2 type of communication	0.0432	0.0486	0.0486	0.0378	0.0216
C3.3 level of tenants say	0.0540	0.0300	0.0300	0.0480	0.0060

C4 Nuisance					
C4.1 duration	0.0559	0.0302	0.0000	0.0544	0.0529
C4.2 decrease living convenience	0.0134	0.0101	0.0034	0.0101	0.0134
C4.3 preparatory activities	0.0128	0.0077	0.0000	0.0051	0.0128
TOTAL	0.5310	0.5546	0.4813	0.5454	0.5097
Normalized TOTAL	0.2025	0.2115	0.1836	0.2080	0.1943
Rank	3	1	5	2	4
REAL TENANT PARTICIPATION	92 %	100 %	100 %	83 %	23%
REAL rank	3	1	2	4	5

Table 21 shows that the total score results in a rank of case 2 with the best score, then case 4, case 1, case 5 and case 3. However, with a score between 0.48 and 0.55 the scores are close to each other. When the calculated rank and the real rank are compared, it shows that the ranking is not the same.

Although the cases were quite diverse, the scores of the cases are close to each other. One explanation for this could be that different criteria balance each other out. For example, when the sustainable renovation project has a big increase of the dwelling improvements, which means that the quality of the dwelling will be greatly improved, this causes a long duration or an increase of other nuisance aspects. This situation was shown in case 3. The opposite was shown in case 1. This case has the least nuisance for the tenants; also the rent increase was the lowest. However, opposite was that case 1 had the lowest dwelling improvement of all cases.

Another aspect which should be mentioned is that although the rent increase is states as being the most important criterion, people are willing to pay for a sustainable renovation. This was shown in all the cases. In the cases the rent increase was between €7.60 and €92.50, but all the project plans lead eventually to a sufficient participation rate.

Case 5 shows that a case with low tenant participation (23%) can have a score which is quite average compared to the other cases with a high tenant participation. Another exception is case 3, which has the lowest score but a real tenant participation rate of 100%. This difference can be explained by external circumstances. As mentioned, the tenants in case 3 were in favor of the sustainable renovation project. In case 5 the opposite was shown, a group of refusing tenants influenced the other tenants to non-participation.

The calculated scores of the cases are close to each other but the rank is not the same as the rank of the calculated scores. Because the scores are so close to each other, it is of interest to know the sensitivity of the cases on the weights of the criteria. This will be performed in the next section.

6.3.3 Sensitivity analysis

The final scores of the alternatives are dependent on the relative importance of the criteria and sub criteria. Changes in the relative importance of the criteria can therefore cause changes on the final ranking (Chang et.al, 2007). Since the relative importance of the criteria is based on the opinion of the project managers, which are subjective judgments, it is of interest to test the stability of the ranking under varying relative importances. For this purpose, sensitivity analysis is performed. Through increasing or decreasing the relative

importance of the individual criteria, the resulting changes of the scores and the ranking of the alternatives can be observed. Sensitivity analysis therefore provides information on the stability of the ranking. If the ranking is highly sensitive to small changes in the relative importance, a careful review of the weights is recommended (Chang et.al, 2007). For this purpose, the relative importance of the main criteria and the most importance sub criteria (C2.3 level of rent increase) are separately increased and decreased with 30% (note that the relative importance of the other criteria change accordingly, because the sum of the relative importances should be 1). In Table 22 the outcomes of the sensitivity analysis is shown. When the number of the ranking is bold, italic and underlined, the rank differs from the base ranking.

Table 22 Sensitivity analysis

Adaptation	Case 1	Case 2	Case 3	Case 4	Case 5	Case 1	Case 2	Case 3	Case 4	Case 5
						3	1	5	2	4
C1 -30%	0,566	0,567	0,436	0,569	0,518	<u>3</u>	<u>2</u>	<u>5</u>	<u>1</u>	<u>4</u>
C1 +30%	0,515	0,544	0,499	0,532	0,500	3	1	5	2	4
C2 -30%	0,519	0,542	0,522	0,535	0,498	<u>4</u>	<u>1</u>	<u>3</u>	<u>2</u>	<u>5</u>
C2 +30%	0,539	0,564	0,452	0,553	0,518	3	1	5	2	4
C3 -30%	0,515	0,547	0,471	0,534	0,518	<u>4</u>	<u>1</u>	<u>5</u>	<u>2</u>	<u>3</u>
C3 +30%	0,546	0,561	0,491	0,556	0,502	3	1	5	2	4
C4 -30%	0,525	0,561	0,500	0,544	0,503	3	1	5	2	4
C4 +30%	0,537	0,549	0,464	0,547	0,515	3	1	5	2	4
C2.3 -30%	0,488	0,528	0,535	0,535	0,474	<u>4</u>	<u>3</u>	<u>2</u>	<u>1</u>	<u>5</u>
C2.3 +30%	0,566	0,577	0,438	0,554	0,538	<u>2</u>	<u>1</u>	<u>5</u>	<u>3</u>	<u>4</u>

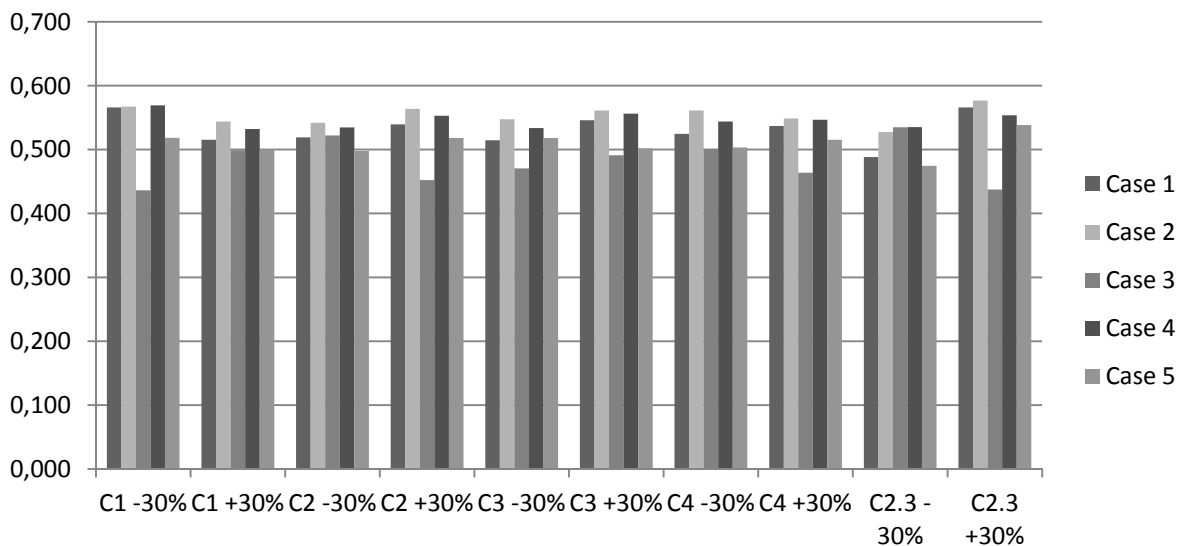


Figure 14 Sensitivity analysis

As shown in Table 22 and Figure 14, in 5 of the 10 analyses the rank changes. This means that the rank of the cases is very dependent on the relative importance of the criteria. The sensitivity of the cases is very high.

6.4 Conclusion

This chapter has tried to give an answer to the following question:

“Is it possible to forecast the effect of a project plan on the tenant participation?”

This question is researched by translating the different aspects of a case into weights for each criterion. In this way a number is given to the content of the project, related to the influence on the tenant participation. This score is eventually compared to the real tenant participation within the cases. Striking was that the scores of the cases are very close to each other while the cases were quite diverse and the real tenant participation differed.

The most striking cases were case 3 and case 5 in which the calculated score and the real score differed the most. In both cases this could be explained by external influences. In case 3 the tenants were in favor of the sustainable renovation in advance. In case 5 a group of refusing tenants influenced the other tenants not to participate. This leads to the conclusion that a certain feeling within the group of tenants, for example resistance or a need for an improved dwelling has a major influence. The tenant participation rate in such case can be unrelated to the score of the project plan.

Another conclusion which can be drawn from the cases is that although the rent increase is states as being the most important criterion, people are willing to pay for a sustainable renovation. This is shown in all the cases and they had a varying rent increase from €7.60 in case 1 up till € 92.50 in case 3. Apparently, the benefits of the renovation project outweighed the possible negative aspects like nuisance. In case 3 the rent increase was higher than the forecasted saving on energy costs. This was because of the improvements of the kitchen and balcony which matched the needs of the tenants.

As a result of the effect of external influences on the cases, the fact that the calculated scores and the real participation rate do not correspond, and the fact that the scores of the cases are very sensitive, the answer to the research question is negative: it is not possible to forecast the effect of a project plan by filling in the different parts and calculate the score in the way this was done in section 6.3. This does not mean that the content of the projects plan does not have influence, but that there are other factors which also have an influence, for example the attitude of the tenant or the social influence of neighbors.

7 Conclusions and recommendations

In this study, research is done to give an answer to the following main question:

“How can a sustainable renovation project be composed in order to encourage the tenants to participate?”

To give answer to this main question, it had to be divided into sub questions. In the conclusions of every chapter an answer is given to these sub questions. They will not be repeated, but the emphasis in this chapter is on the most important findings and their interpretation. The most important findings and how they contribute to the main question are described in section 7.1. After that recommendations will be given in section 7.2. This chapter ends with a discussion and suggestions for further research in sections 7.3 and 7.4.

7.1 Most striking results and conclusions

Based on the research performed in this report, several conclusions could be drawn. Several aspects were striking and will be discussed in this chapter. These are differences between literature and the survey, the willingness of the tenants and the project managers' disunity.

7.1.1 Differences between the literature and the survey

When the relative importances of the criteria are determined by the project managers, it is interesting to compare these results with the relative importances determined from the literature. In Figure 15 the importances from the literature (LI) are plotted against the importances from the survey (RI). The criteria are horizontally divided into low, medium and high. Vertically, the criteria are also divided into three groups, in which the median of the values ($RI = 0.06$) made the first division (light grey and grey). A second division was made by taking 2 times the median value which is at a RI of 0.12 (between grey and dark grey).

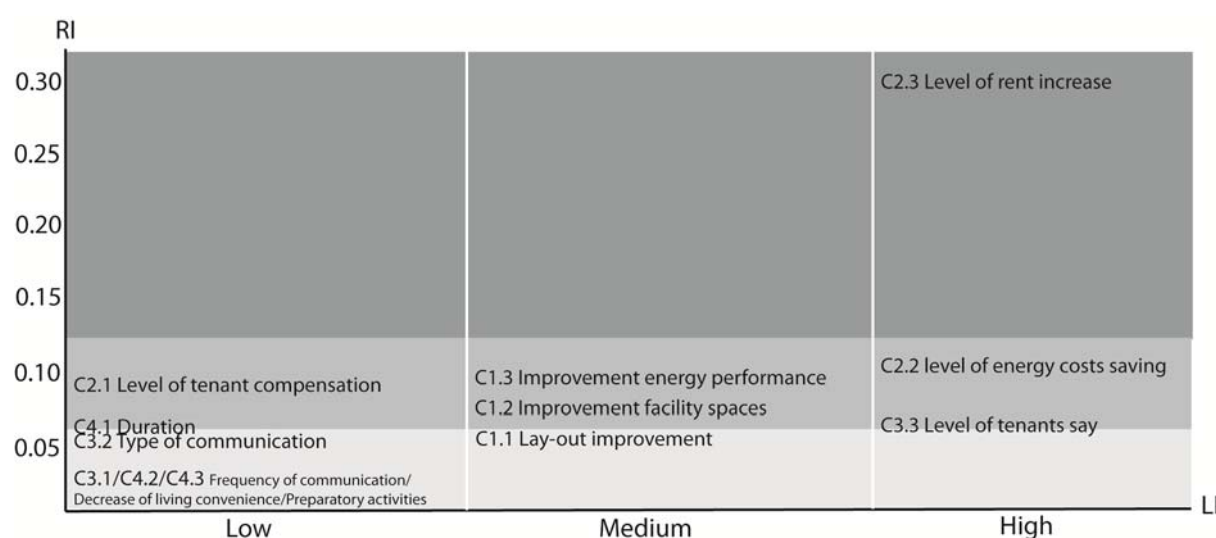


Figure 15 Comparison of the importances

7.1.1.1 Level of tenants' say

In general, the preliminary statement is to a great extent confirmed by the experience of the project managers. Criteria which have a low influence in the preliminary statement also have a low relative importance according to the project managers most of the time. The same goes for criteria with medium and high influence. However, there are exceptions of which C3.3 (level of tenants' say) is the first one. This criterion was substantiated from literature as

a criterion with a high level of influence. But with a relative importance of 0.060 the high importance is not confirmed by the project manager.

This difference can be explained in a few ways. The first explanation for this difference is that the criterion is underestimated by the project managers or overestimated by the literature. Although in 4 of the 5 cases tenants had influence in the decision-making process, this influence was minimal. When a focus group had a vote in the contracting, this vote was too small (10%) to really make a difference. Also the possibility to choose the color of the paint for the window frames is not something which significant matters to the housing association. By an expert from Atrienis was confirmed that the voice tenants have in a sustainable renovation project is most of the time to give the tenant the feeling of influencing, but that this has a minimal effect on the content of the project plan. This could explain the difference in data: when the tenant has a vote in the decision-making process, the feeling of having a say is bigger than the real level of influence they have.

7.1.1.2 Level of rent increase

As shown in Figure 15, the position of C2.3 (level of rent increase) lies outside the average positions of the criteria. However the influence of the level of rent increase was considered to be high according to both the literature as the project managers, the degree of importance is disproportionately. It is striking that this aspect is of such a big importance because in every case the renovation has the goal to decrease the integrated housing costs for the tenant.

A possible explanation for this is that in every project, the level of rent increase contributes to the decision and the other criteria do not play a role in every project. This does not mean that in one project, the level of rent increase is substantially more important, but that when all the experiences of the project managers are summed the level of rent increase overall plays the biggest role.

Although the degree of importance is probably out of proportion, it is still the most important criterion. However, this does not mean that the higher the rent increase, the more difficult it is to convince the tenants to participate, but that the level of rent increase should fit the needs and ability of the tenants. However, at the end of a renovation the integrated housing costs are calculated to be lower than before the renovation, due to decreasing energy costs. So, why is the level of rent increase so much more important than C2.2 (level of energy costs saving)?

The first possible explanation is that the level of rent increase is fixed, and the calculated saving on energy costs is an estimation. Therefore it is a risk for the tenant to participate because the saving can be lower than estimated. It should be taken into account that for the feeling of the tenant, the higher the level of rent increase, the higher the risk feeling. Moreover, most of the time the rent increase is applied soon after the renovation, while the advanced payment of the energy bill is decreased after a new calculation of the energy use, most of the time after a half year. For tenants of social housing with a low income, the rent increase can cause financial difficulties when the tenants do not benefit from the sustainable renovation immediately.

7.1.2 Willingness of the tenants

The cases showed that tenants are willing to pay rent increase for a sustainable renovation, and even are willing to pay more than the calculated energy saving when they get an improved dwelling in return for the rent increase. This means that when the benefits are high enough according to the tenants, it is possible to perform profound renovations.

A certain feeling within the group of tenants can have a major influence. This can resistance which can be stimulated by the social influence of neighbors or in contrary a demand for an improved dwelling because of complaints about the energy performance. The tenant participation rate in such case can be more based on these tenant group opinions than on the content of the project plan.

7.1.3 Project managers disunity

During the analysis of the data, it was striking that the project managers had very diverse opinions about the most influencing criteria. This led to the conclusion that 'younger' project managers put more emphasis on the tenant approach than 'older' project managers, and that project managers are influenced by the characteristics of the housing association they work for. Although there is no evidence that this directly leads to less tenant participation, it is recommendable that project managers are aware of this fact and are open to the experience of other project managers.

7.2 Recommendations

In the last section of every chapter the conclusions about that chapter and the corresponding research question were given. In section 7.1 the most striking results and corresponding conclusions and interpretations were described. The content of all these sections lead to recommendations for project managers to effectively give substance to a project plan, with the aim to let the tenants participate. Three main steps to approach the tenant are described. This section ends with a checklist to improve the project plan aiming at the tenant participation.

7.2.1 Understand, want, be able

The first recommendation is based on the conclusion that a project plan should focus on the tenants' needs (see section 4.6). This means that tenants have to *understand*, *want*, and *be able to deal with* the sustainable renovation, in order to participate. This is shown in Figure 16 and is called the decision road. These three factors are goals which should be achieved by the project plan.



Figure 16 tenants' decision road

Every aspect of the project plan should follow the path of the arrows. Hereby, especially the financial factors should be taken into account. For a tenant, the total picture of the plan should fit also. The benefits should be in balance with the nuisance. Tenants are willing to pay for rent increase when on the other hand the benefits like a decrease of energy costs and increase of living comfort are present (see section 6.4). When the housing association

had plans for a building complex of which the tenants do not think they are immediately necessary, it is important to try to convince the tenant that it is important. Below, tips are given to run through the decision road more successfully.

Table 23 Tips to run through the decision road

Understand	<ul style="list-style-type: none"> - Maintain a clear structure of the information leaflets and letters - Do not use pretentious language - Create a low threshold for questions or comments from the tenant about the project
Want	<ul style="list-style-type: none"> - Argue from the problem of the tenant and show them the need for the improvement - Give the tenants the feeling they have a say - Be honest about the financial consequences and keep the financial risk for the tenant low - Invest in a good relationship between the tenant and the housing association - Show the improvements in a model dwelling
Be able to	<ul style="list-style-type: none"> - Match the financial risk with the financial circumstances of the tenant - Adapt the help to the tenants' characteristics and limit the nuisance - Work in one dwelling as short as possible - Guarantee the safety of the tenant and their property

7.2.2 Checklist

Although the project plans keep personalized reports, a procedure aiming at the implementation of the needs of the tenant could help improving the project plan. This is helpful because the project plan definitely has influence on the decision of the tenant to participate or not.

When a housing association wants to perform a sustainable renovation project and they need the participation of tenants, they have to keep in mind that it is their responsibility to convince the tenants. By presenting a checklist based on the findings of this research, project managers are helped to improve their project plan with the aim to get enough tenant participation in an efficient way.

PROJECT PLAN CHECKLIST FOR THE PROJECT MANAGER

Before intern	<ul style="list-style-type: none"> • What do you know about the tenants and their needs? • Make an inventory within the organization, what is the history of and experience with the building complex and their tenants? • Are limitations due to the tenant type, age, financial situation, young children, etcetera • To what extent do you want to involve the tenants? Is there already a residents committee?
Before extern	<ul style="list-style-type: none"> • Make an inventory via a survey to the tenant about the needs and complaints of the tenants • Is there a collective opinion among the tenants?

During the design	<ul style="list-style-type: none"> • To what extent do the tenants want to be involved? • Does the project plan match with the needs of the tenant? • What are the main subjects to communicate? <ul style="list-style-type: none"> - What are you going to do in the building complex, how long does this take? - What is the reason to do this renovation? - Why should tenants participate? - What is the result if they participate in terms of finance, living comfort and nuisance • Does the description fit on one paper? • Look again at the financial part <ul style="list-style-type: none"> - Is it clear that the tenant benefits from the renovation? - Is it understandable? - Is the rent increase adapted to the energy use of the household? Should it be? • Include a telephone number for questions
During the execution	<ul style="list-style-type: none"> • Use a focus group for (at least) consultation • Check if the tenants understand what is going on and what is expected of them • Be accessible for questions and comments • Be service oriented and help tenants when necessary • Ask afterwards if the tenants are satisfied

7.3 Discussion

After this research is performed, it is important to keep in mind possible pitfalls in the research. In this section a critical view on this research will be given.

The first discussion point is the use of AHP in this research. AHP is originally a method to identify the best choice within a group of alternatives, based on the preferences of the stakeholders. In this research the AHP method is used in an alternative way. First by asking the project managers about how they estimate the opinion of another group of persons, the tenants, and second by not searching for the best alternative but using the information to assess cases. Although it is an original approach, it is possible that the AHP is not the best way to apply this research. Particular the application of the cases within the AHP raises the question if this was the way to get the best results.

The next discussion point is the differences in the opinion of the project managers. Because of this large diversity, the question rises how random the answers are. The fact that project managers have such different opinions based on their experience questions the quality of the combined outcomes.

The last discussion point is the relation of the influence between the criteria and the tenant participation. In the research this relation is stated as unilateral (positive or negative) and linear. It is discussable to what extent this is correct. For example the level of rent increase. It is thinkable that for a tenant the difference between € 10,- and € 20,- influences their decision in another way than a difference between € 40,- and € 50,- .

7.4 Further research

After this research is performed it would be interesting to do further research on some topics. These are described in this section.

For a housing association there are several ways to deal with the financial aspects like investment costs and rent increase. It would be interesting to do research on the different possibilities and which one is the best for both the housing association as the tenant.

In advance of this report, literature research was done by the author on the implementation of sustainable policies within housing associations which is an interesting topic in which several barriers were identified. A total integration of sustainable goals within the organization can have several benefits. Further research on this topic would be very interesting.

References

- Adamcsek, E. (2008) *The analytical Hierarchy Process and its Generalizations*. Eötvös Loránd University: Budapest
- Aedes (2012) *Besluit beheer sociale huursector*. Obtained from <http://www.aedes.nl/content/dossiers/Huurbeleid.xml>
- Arnstein, S.R. (1969) A Ladder of Citizen Participation, *Journal of the American Planning Association*, 4, 216-224
- Atriensis (2012) *Invoering energiebeleid door corporaties onder de loep*. Atriensis: Eindhoven
- Borst, C., Mossel, H., Straub, A. (2006) *Prestatiegericht samenwerken bij onderhoud. Stimulans voor innovaties in het onderhoudsbedrijf*. Habiforum: Gouda
- CBS (2011) *Woningbouw: Voorraad, wijzigingen en nieuwbouw naar voortgang, per regio*. Obtained from <http://statline.cbs.nl/StatWeb/publication/?VW=T&DM=SLNL&PA=7413&D1=0-3&D2=0&D3=a&HD=091119-1347&HDR=T&STB=G1,G2>
- Chang, C.W., Wu, C.R., Lin, C.T., Chen, H.C. (2007) An application of AHP and sensitivity analysis for selecting the best slicing machine. *Computer and Industrial engineering*, 52, 296-307
- Dalen, J.P. van et al (2007) *Stromen Dossier – EPBD in de praktijk*, SDU: Den Haag
- DeltaWonen (2010) *Durf en duurzaamheid - ondernemingsplan DeltaWonen 2010-2015*. Report, DeltaWonen: Zwolle
- Dijkstra, A., Brouwer, J. (2010) *Bewonerscommunicatie bij duurzame woningverbetering – Praktisch handboek voor projectleiders en hun medespelers*, Æneas, uitgeverij van vakinformatie BV: Boxtel
- EnergyCouncil (2002) *Energy Performance Building Directive of the European Parliament and Council*, Energy Council: Manchester
- Europees Parlement & de raad van de Europese Unie (2002) *Richtlijn 2002/91/EG van het Europees Parlement en de Raad - betreffende de energieprestatie van gebouwen*, European Parliament: Brussel
- Groot, E. de, Spiekman, M., Opstelten, I. (2008) *Dutch Research into User Behaviour in Relation to Energy Use of Residences*. Proceedings of PLEA 2008 – 25th Conference on Passive and Low Energy Architecture. PLEA: Dublin
- Guerra Santin, O., Itard, L., and Visscher, H. (2009) The effect of occupancy and building characteristics on energy use for space and water heating in Dutch residential stock. *Energy and Buildings*, 41(11), 1223-1232
- Hoppe, T., Lulofs, K. (2008) The impact of multi-level governance on energy performance in the current Dutch housing stock. *Energy & Environment*, 19(6), 819-830
- Khalil, M.I.A. (2002) Selecting the appropriate project delivery method using AHP. *International journal of project management*, 20, 469-474

Lin, C.C., Wang, W.C., Yu, W.D. (2008) Improving AHP for construction with an adaptive AHP approach, *Automation in construction*, 17(2), 180-187

Marzouk, M., Moselhi, O. (2003) A decision support tool for construction bidding, *Construction Innovation*, 3, 111-124

Ministry of internal affairs, Aedes, Woonbond, Vastgoedbelang (2012) *Covenant energie saving rental sector*

Nauwelaerts de Agé, S. (2010) *Het verhuurzamen van de sociale woningvoorraad, tussen droom en werkelijkheid*. TU/e: Eindhoven

Otter, H.J. den (2009) *Woningvoorraadgegevens Syswov 2008*, ABF RESEARCH: Delft

Quirijns, P. (2011) *Complex gemengd complex, een exploratief onderzoek naar de belemmering voor woningcorporaties bij het doorvoeren van energiebesparende maatregelen binnen gemengde wooncomplexen*, TU/e: Eindhoven

Saaty, T.L. (1980) *The Analytic Hierarchy Process*, McGraw-Hill: New York

Saaty, T.L. (1987) The analytic hierarchy process, what is it and how it is used, *Match modelling*, 9(5), 161-176

Saaty, T.L. (1990) How to make a decision, the Analytical Hierarchy Process, *European Journal of Operational Research*, 48, 9-26

Saaty, T.L. (2003) Rank, normalization and idealization in the analytical hierarchy process, Proceedings of the 7th ISAHP 2003 Bali Indonesia August 7-9, ISAHP: Bali

Saaty, T.L. (2006) Rank from comparisons and from ratings in the analytical hierarchy/network processes, *European Journal of Operational Research*, 168, 557-570

Saaty, T.L., Vargas, L.G. (1994) Comparison of eigenvalue, logarithmic least squares and least squares methods in estimating ratios. *Mathematics and Modeling*, 5, 309-324

Schalkwijk, M. en Mulder, S. (2009) *Gevelisolatie in Nederland – Kansen en barrières voor gevelisolatie in oudere woningen*, TNS NIPO: Amsterdam

Schillemans, R.A.A., Rooijers, F.R., Benner, J.H.B. (2006) *Belemmeringen binnen en buiten de muren*. CE: Delft

SenterNovem (2012) *Monitor energiebesparing, energielabel en energieprijzen*. Obtained from http://senternovem.databank.nl/quickstep/QsBasic.aspx?cat_open=energielabels

Spank, M. van der (2013) *Convincing tenants to participate in sustainable renovation*. Eindhoven: TU/e

Srdjevic B., Srdjevic, Z. (2013) Synthesis of individual best local priority vectors in AHP-group decision making, *Applied soft computing*, 13, 2045-2056

Straub, A., & Vijverberg, G.A.M. (2002) *Verbeteren van de woontechnische kwaliteit van de sociale huurwoningvoorraad*, NETHUR: Utrecht

Sunikka, M.M. (2006) *Policies for improving energy efficiency in the European housing stock*. IOS Press BV: Delft

Tambach, M., Hasselaar, E., Itard, L. (2010) Assessment of current Dutch energy transition policy instruments for the existing housing stock. *Energy Policy*, 38(2) 981-996.

Werf, E. van der (2011) *Bewonersbelangen bij renovatie in bewoonde staat*. Technische Universiteit Delft: Delft

WijksteunpuntWonen (2011) *Verslag informatieavond over energiebesparing*. Airey Energy: Amsterdam

Zayed, T., Amer, M., Pan, J. (2008) Assessing risk and uncertainty inherent in Chinese highway projects using AHP, *International journal of project management*, 26, 408-419

Appendices

Appendix 1 survey sent to the project managers

Bewonersparticipatie bij duurzame renovatieprojecten

Introductie

Pagina 1 van 9

Geachte respondent,

In samenwerking met Atrienis en de Technische Universiteit Eindhoven doe ik een afstudeeronderzoek naar de bewonersparticipatie binnen duurzame renovatieprojecten. Hierbij zou ik graag van u willen weten welke factoren u denkt dat de meeste invloed hebben op de keuze van bewoners om wel of niet te participeren in een duurzaam renovatieproject. Uw antwoorden worden vervolgens vergeleken met eerdere onderzoeken en met cases om tot aanbevelingen te komen om de bewonersparticipatie te vergroten.

U bent uitgekozen om deze enquête in te vullen door uw werkzaamheden binnen een woningbouwcorporatie. Gezien de beperkte omvang van de doelgroep van deze vragenlijst stel ik het zeer op prijs als u deze enquête volledig invult. De verwachte tijd die u hiermee kwijt bent is 10-15 minuten.

Aan het einde van de enquête heeft u de mogelijkheid om uw emailadres achter te laten, u ontvangt dan achteraf een samenvatting van het onderzoek.

Alvast bedankt en met vriendelijke groet,

Susan Reuvekamp

Duurzaam renovatieproject: een renovatieproject met als doel de energetische prestatie van het woningcomplex te verbeteren, al dan niet in combinatie met andere werkzaamheden.

Heeft u ervaring met duurzame renovatieprojecten binnen uw corporatie?

Hoeveel jaar heeft u ervaring met duurzame renovatieprojecten?

volgende

Bewonersparticipatie bij duurzame renovatieprojecten

Uitleg

Pagina 2 van 9

Uitleg van de enquête, lees u deze alstublieft door.

Deze enquête gaat over de factoren die invloed hebben op de keuze van bewoners om wel of niet te participeren in duurzame renovatieprojecten. Graag zou ik van u willen weten welke variabelen volgens u de meeste invloed hebben op deze keuze, vanuit uw ervaring.

In deze enquête krijgt u steeds een tabel te zien. In deze tabel staan variabelen paarsgewijs tegenover elkaar. De vraag is telkens 'hoeveel invloed heeft de ene variabele op de bewonersparticipatie ten opzichte van de andere variabele?'. Als bijvoorbeeld de linker variabele veel meer invloed heeft op bewonersparticipatie dan de rechter variabele, dan klinkt u op het linker hokje waarboven 'veel meer invloed' staat. Als beide variabelen ongeveer dezelfde invloed hebben, dan klikt u op het middelste hokje waarboven 'evenveel invloed' staat, etc...

Bij het opstellen van deze enquête zijn vier hoofdvariabelen opgesteld: verbetering van de woning, financiële factoren, bewonersbenadering en overlast. Deze worden tegenover elkaar gezet in de vergelijkingen. De hoofdvariabelen bestaan op hun beurt telkens uit drie sub-variabelen, die ook weer tegenover elkaar gezet zullen worden. Hierdoor bestaat de enquête uit vijf groepen van variabelen (1x de hoofdvariabelen en 4x de sub-variabelen groepen) die u tegen elkaar moet afwegen.

De uitleg van de verschillende variabelen staat op de volgende pagina én telkens onderaan de bladzijde.

[vorige](#)

[volgende](#)

Bewonersparticipatie bij duurzame renovatieprojecten

Variabelen

Pagina 3 van 9

De volgende variabelen zijn meegenomen in deze enquête:

Verbetering woning

- *verbeteren van de plattegrond*: bijvoorbeeld het verwijderen van de tussenwand tussen de keuken en de woonkamer, het samenvoegen van twee slaapkamers of het vergroten van een balkon.
- *verbeteren van de keuken, badkamer en/of toilet ruimtes*: het renoveren van de keuken, badkamer of toilet.
- *verbeteren van de energieprestatie*: bijvoorbeeld het isoleren van de schil waaronder het aanbrengen van HR++ glas of het installeren van vraaggestuurde mechanische ventilatie.

Financiële factoren

- *hoogte van de ongemakkenvergoeding*: de hoogte van het bedrag dat wordt uitgekeerd om de overlast van de werkzaamheden te compenseren.
- *hoogte van de verwachte besparing*: de hoogte van het verwachte bedrag dat zal worden bespaard op de energierekening na uitvoering van de renovatie.
- *hoogte van de huurverhoging*: de hoogte van het bedrag waarmee de huur omhoog zal gaan na uitvoering van de renovatie.

Bewonersbenadering

- *het aantal communicatiemomenten*: het aantal momenten waarop georganiseerde communicatie is tussen de bewoner en de corporatie over de renovatieplannen.
- *het type communicatiemomenten*: de vorm van de momenten van communicatie, bijvoorbeeld via een enquête over de woonwensen, op een bewonersavond of via een modelwoning.
- *de hoeveelheid inspraak die bewoners hebben*: het inspraakniveau, bijvoorbeeld 'de bewoners hebben geen inspraak', 'de bewoners mogen meedenken via een bewonerscommissie', 'de bewoners mogen gedeeltelijk meebeslissen'.

Overlast en overlastbeperking

- *duur van de werkzaamheden*: het aantal dagen dat de renovatie duurt bij één woning
- *de afname van de leefbaarheid*: de mate van verminderde mogelijkheden voor bewoners om te douchen/wassen/koken tot aan het tijdelijk moeten verhuizen.
- *de voorbereidende activiteiten*: de mate van voorbereiding voor de bewoners, bijvoorbeeld het moeten afdekken van spullen tot aan het moeten verhuizen van alle meubels.

[vorige](#)

[volgende](#)

Bewonersparticipatie bij duurzame renovatieprojecten

Hoofdcriteria

Pagina 4 van 9

Vergelijk de invloed van de variabelen ten opzichte van de bewonersparticipatie, welke variabele is volgens u meer van belang?

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Verbetering woning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Financiële factoren
Verbetering woning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Bewonersbenadering
Verbetering woning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Overlast en overlastbeperking
Financiële factoren	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Bewonersbenadering
Financiële factoren	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Overlast en overlastbeperking
Bewonersbenadering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Overlast en overlastbeperking

[vorige](#)

[volgende](#)

Verbetering woning: de verbetering van de woning bestaat uit het verbeteren van de plattegrond, het verbeteren van de keuken/badkamer/toilet en het verbeteren van de energieprestatie van de woning.

Financiële factoren: de financiële factoren zijn de hoogte van de ongemakkenvergoeding, de hoogte van de verwachte besparing en de hoogte van de huurverhoging.

Bewonersbenadering: de bewonersbenadering bestaat uit het aantal communicatiemomenten, het type communicatiemomenten en de hoeveelheid inspraak die bewoners hebben.

Overlast en overlastbeperking: de overlast en overlastbeperking bestaat uit de duur van de werkzaamheden in dagen binnen de woning, de afname van de leefbaarheid door bijvoorbeeld het niet kunnen wassen, douchen of slapen en de voorbereidende activiteiten die bewoners moeten nemen, bijvoorbeeld het verplaatsen van meubels of het afdekken van de vloerbedekking.

Bewonersparticipatie bij duurzame renovatieprojecten

Woning verbetering

Pagina 5 van 9

Vergelijk de invloed van de variabelen ten opzichte van de woning verbetering, welke variabele is volgens u meer van belang?

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Verbetering plattegrond	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Verbetering facilitaire ruimtes
Verbetering plattegrond	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Verbetering energieprestatie
Verbetering facilitaire ruimtes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Verbetering energieprestatie

[vorige](#)

[volgende](#)

Verbetering woning

- **verbeteren van de plattegrond:** bijvoorbeeld het openbreken van de muur tussen de keuken en de woonkamer, het samenvoegen van twee slaapkamers of het vergroten van een balkon.

- **verbeteren van de facilitaire ruimtes:** het renoveren van de keuken, badkamer of toilet.

- **verbeteren van de energieprestatie:** bijvoorbeeld het isoleren van de schil, aanbrengen van HR++ glas of het installeren van mechanisch gestuurde ventilatie.

Bewonersparticipatie bij duurzame renovatieprojecten

Financiële factoren

Pagina 6 van 9

Vergelijk de invloed van de variabelen ten opzichte van de financiële factoren, welke variabele is volgens u meer van belang?

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Hoogte ongemakkenvergoeding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Hoogte verwachte besparing
Hoogte ongemakkenvergoeding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Hoogte huurverhoging
Hoogte verwachte besparing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Hoogte huurverhoging

[vorige](#)

[volgende](#)

Financiële factoren

- *hoogte van de ongemakkenvergoeding*: de hoogte van het bedrag dat wordt uitgekeerd om de overlast van de werkzaamheden te compenseren.
- *hoogte van de verwachte besparing*: de hoogte van het verwachte bedrag dat zal worden bespaard op de energierekening na uitvoering van de renovatie.
- *hoogte van de huurverhoging*: de hoogte van het bedrag waarmee de huur omhoog zal gaan na uitvoering van de renovatie.

Bewonersparticipatie bij duurzame renovatieprojecten

Bewonersbenadering

Pagina 7 van 9

Vergelijk de invloed van de variabelen ten opzichte van de bewonersbenadering, welke variabele is volgens u meer van belang?

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Aantal communicatiemomenten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Type communicatiemomenten
Aantal communicatiemomenten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Hoeveelheid invloed
Type communicatiemomenten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Hoeveelheid invloed

[vorige](#)

[volgende](#)

Bewonersbenadering

- *het aantal communicatiemomenten*: het aantal momenten waarop georganiseerde communicatie is tussen de bewoner en de corporatie over de renovatieplannen.
- *het type communicatiemomenten*: de vorm van de momenten van communicatie, bijvoorbeeld via een enquête over de woonwensen, op een bewonersavond of via een modelwoning.
- *de hoeveelheid inspraak die bewoners hebben*: het inspraakniveau, bijvoorbeeld 'de bewoners hebben geen inspraak', 'de bewoners mogen meedenken via een bewonerscommissie', 'de bewoners mogen gedeeltelijk meebeslissen'.

Bewonersparticipatie bij duurzame renovatieprojecten

Overlast en overlastbeperking

Pagina 8 van 9

Vergelijk de invloed van de variabelen ten opzichte van de overlast en overlastbeperking, welke variabele is volgens u meer van belang?

	heel veel meer invloed	veel meer invloed	meer invloed	iets meer invloed	evenveel invloed	iets meer invloed	meer invloed	veel meer invloed	heel veel meer invloed	
Duur werkzaamheden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Afname leefbaarheid
Duur werkzaamheden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Vorbereidende activiteiten
Afname leefbaarheid	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Vorbereidende activiteiten

vorige

volgende

Overlast en overlastbeperking

- *duur van de werkzaamheden*: het aantal dagen dat de renovatie duurt bij één woning
- *de afname van de leefbaarheid*: de mate van verminderde mogelijkheden voor bewoners om te douchen/wassen/koken tot aan het tijdelijk moeten verhuizen.
- *de voorbereidende activiteiten*: de mate van voorbereiding voor de bewoners, bijvoorbeeld het moeten afdekken van spullen tot aan het moeten verhuizen van alle meubels.



Bewonersparticipatie bij duurzame renovatieprojecten

Afsluiting

Pagina 9 van 9

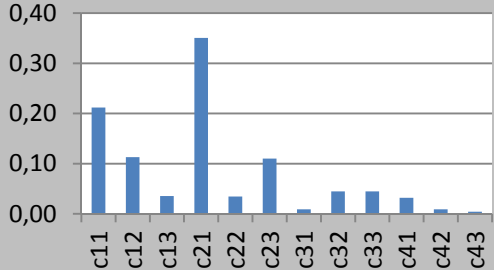
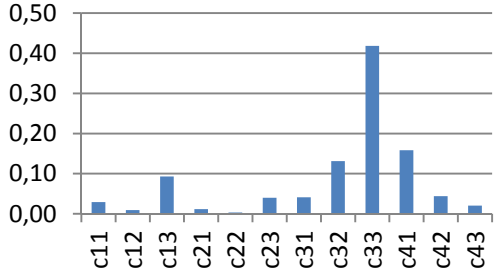
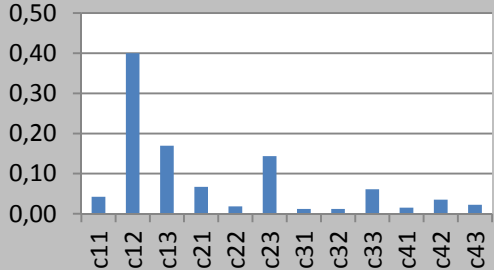
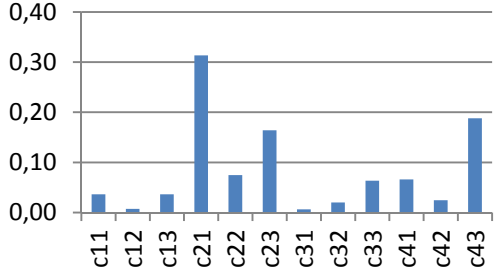
Hartelijk dank, dit is de laatste pagina.

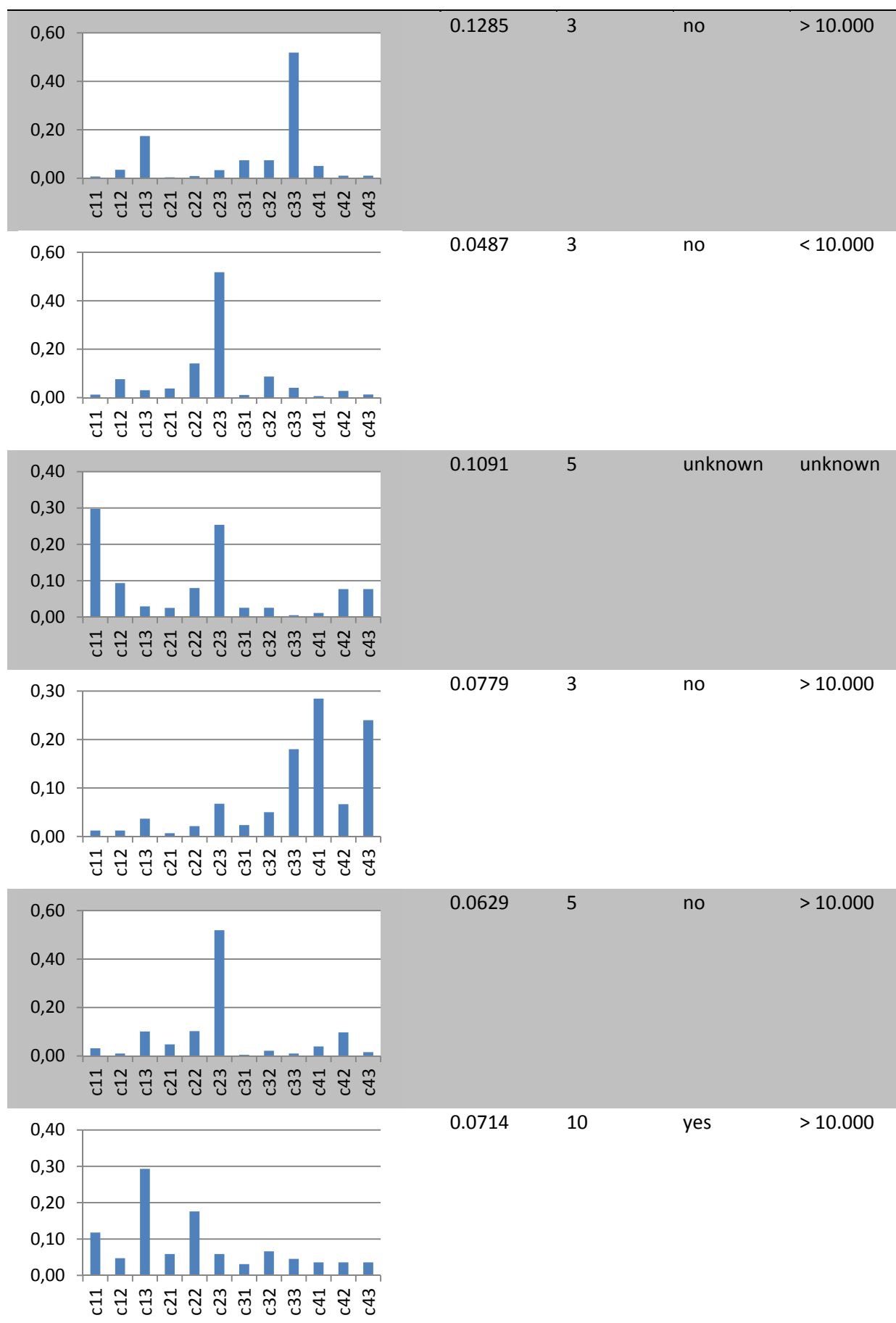
U kunt de enquête nu insturen. Als u geïnteresseerd bent in een samenvatting van het onderzoek, vul dan uw emailadres in.

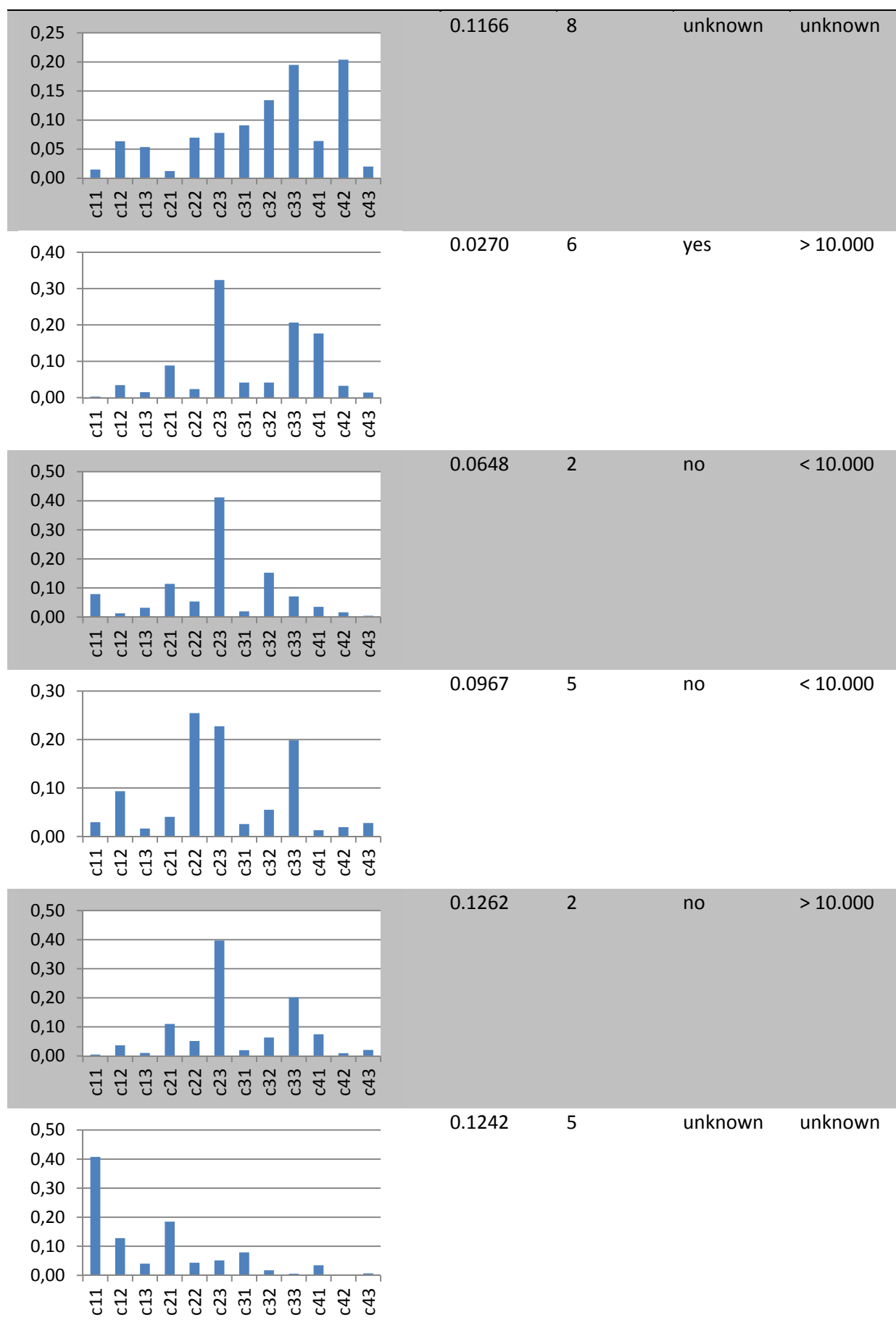
vorige

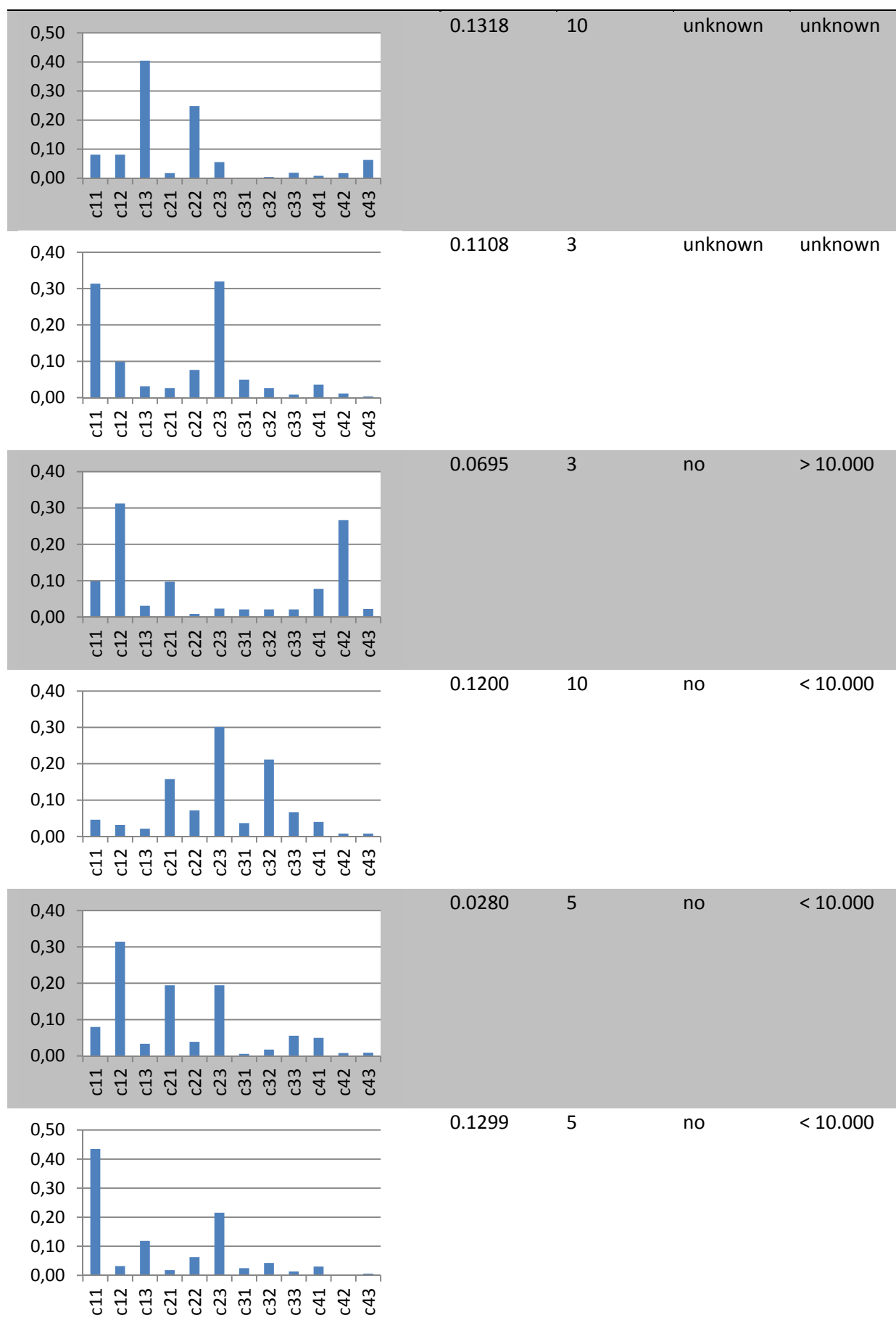
Insturen

Appendix 2 data consistent respondents and characteristics

Result	Respondent consistency ratio	Years experience	Restructuring housing association	Number of housing units
	0.0855	3	no	< 10.000
	0.1082	1	no	< 10.000
	0.1210	5	no	< 10.000
	0.1249	4	no	< 10.000







Kenmerken van referentiegroepen

Onderstaand overzicht geeft voor tien van de 11 referentiegroepen die het Centraal Fonds onderscheidt een beeld van de kenmerken van de referentiegroepen. Voor de referentiegroep overige corporaties is geen informatie opgenomen, omdat dit een restgroep is van corporaties die verder niet goed zijn in te delen. De volledige namen van de referentiegroepen zijn als volgt:

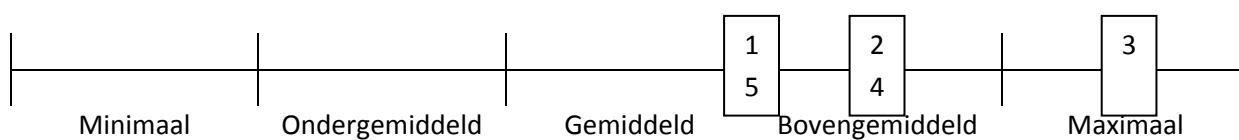
REF1 = Studentenhuysvesting
 REF2 = Ouderenhuysvesting
 REF3 = Grote herstructureringscorporaties
 REF4 = Middelgrote en kleinere herstructureringscorporaties
 REF5 = Gemiddeld profiel
 REF6 = Gemiddeld profiel met accent op eengezinswoningen
 REF7 = Gemiddeld profiel met krimpende portefeuille
 REF8 = Corporaties met relatief jong bezit
 REF9 = Corporaties met marktgevoelig bezit
 REF10 = Corporaties met stabiele portefeuille

Bedrijfsvoering	REF1	REF2	REF3	REF4	REF5	REF6	REF7	REF8	REF9	REF10	NL
Netto bedrijfslasten (in € per VHE in 2009)	832	1.120	1.549	1.462	1.317	1.299	1.531	1.167	1.321	1.286	1.396
Ontwikkeling netto bedrijfslasten (toename 2006-2009 in %)	-19,7	16,6	29,4	23,3	21,6	24,0	14,2	15,3	15,8	26,2	19,5
Netto kasstroom (exclusief verlopen) (in € per VHE in 2009)	1.230	3.605	1.828	1.556	2.235	2.016	2.054	2.974	2.105	1.945	2.042
Bruto stichtingskosten nieuwbouw huur (realisatie 2009 in %)	83.469	202.928	176.273	172.283	172.581	184.056	187.441	160.595	179.829	200.120	174.866
Uitgave per renovatie/verbetering (in € per gerenoveerde/verbeterde woning in 2009)	14.779	13.142	31.851	17.473	11.948	8.888	16.114	17.826	12.235	4.335	15.948
Netto verkoopresultaat nieuwbouw koopwoningen (in € per verkochte woning in 2009)	0	11.250	12.367	-1.394	-43	8.528	-12.293	-3.163	10.000	0	4.464
Bruto verkoopprijs aan eigenaars-bewoners (in € per verkochte woning in 2009)	139.875	156.622	138.254	147.315	153.287	139.258	127.179	168.276	122.138	170.824	139.963
Rentendeckingsgraad (tengetal 2009)	1,5	1,6	1,3	1,3	1,5	1,7	1,5	1,3	1,7	1,8	1,5

Appendix 4 Example of the classification of a descriptive criterion

Overlast tijdens renovatie

Case 1	Case 2	Case 3	Case 4	Case 5
De bewoners konden blijven wonen, echter moesten wel meubels aan de kant en de vloer afgedekt.	De bewoners konden blijven wonen, echter moesten wel meubels tijdelijk weg en de vloer afgedekt. GWE was gegarandeerd voor 7:30 's ochtends en na 17:00 's avonds	De bewoners moesten hun huis uit. Vervangende woning was geregeld.	De bewoner konden blijven wonen, er was een periode geen verwarming, hiervoor werden straalkachels geregeld.	De bewoners konden blijven wonen. Het meeste werk werd aan de buitenkant van de woning gedaan, tenzij de vloer vervangen werd.



Appendix 5 Idealized weight and relative importance

Criteria	Idealized weight 1	Idealized weight 2	Idealized weight 3	Idealized weight 4	Idealized weight 5	Relative importance
C1 Dwelling renovation						
C1.1 lay-out improvement	0,00	0,00	1,00	0,00	0.00	0,058
C1.2 improvement facility spaces	0,00	0,00	1,00	0,00	0.00	0,084
C1.3 improvement energy performance	0,33	1,00	1,00	0,67	0.67	0,100
C2 Financial aspects						
C2.1 level of tenant compensation	0,00	0,26	1,00	0,00	0.00	0,093
C2.2 level of energy costs saving	0,19	0,42	0,42	1,00	1.00	0,109
C2.3 level of rent increase	0,92	0,80	0,00	0,64	0.64	0,300
C3 Tenant approach						
C3.1 frequency of communication	1,00	0,80	0,80	1,00	1.00	0,023
C3.2 type of communication	0,80	0,90	0,90	0,70	0.70	0,054
C3.3 level of tenants say	0,90	0,50	0,50	0,80	0.80	0,060
C4 Nuisance						
C4.1 duration	0,93	0,50	0,00	0,90	0.90	0,060
C4.2 decrease living convenience	0,40	0,30	0,10	0,30	0.30	0,034
C4.3 preparatory activities	0,50	0,30	0,00	0,20	0.20	0,026

*Score criterion = idealized weight criterion * relative importance criterion*

Summaries

TENANT PARTICIPATION IN SUSTAINABLE RENOVATION PROJECTS

The influence of project content on the tenant participation of sustainable renovation project within housing associations, using AHP and case study.

Author

S. (Susan) Reuvekamp

Graduation program

Construction Management and Urban Development 2012-2013
Eindhoven University of Technology

Graduation committee

Prof. dr. ir. Wim Schaefer (TU/e)
Dr. ir. Brano Glumac (TU/e)
Linda Groenen MSc. (Atrienensis)

Graduation date

August 28th 2013

Abstract

This paper is about tenant participation in sustainable renovation projects performed by Dutch housing associations. By law is stated that in most cases, 70% of the tenants have to participate before the renovation plans can be executed. For housing associations this participation level can be a problem with the consequence that sustainable renovation projects are postponed or stopped. This research investigated the content of the project plans and their influence on the tenant participation. This is done by literature study, a survey distributed around project managers and case study.

The most important conclusions were that a project plan has to be understandable, beneficial and within the ability of the tenant. The most important factor herein the level of rent increase, even though the aim of the sustainable renovation project is to lower the energy costs and thus lower the integral housing costs for the tenant. This research ends with a checklist with tips for project managers to give substance to the sustainable renovation plans.

Keywords: tenant participation, integrated housing costs, sustainable renovation, willingness to participate, housing association, social rent

Introduction

As a response to worldwide environmental issues, a new subject has become increasingly important for the built environment: energy. Within the European Union the energy use by the built environment is over 40% of the total energy consumption and 30% of the total CO₂ emission (EnergyCounsil, 2002). In 2008, the Dutch government responded to the energy topic and the EPBD by making it obligatory for Dutch dwelling owners to have an energy label for their dwelling. An energy label shows the energy performance of the dwelling and

can only be determined by an authorized certified advisor. The label of a dwelling can vary from A: 44 points and thus highly energy efficient to G: 0 points and thus not energy efficient. The points are based on several characteristics of the dwelling that influence the energy efficiency. For example the size, window surface, materials and installations. An energy label is made obligatory to stimulate energy reducing measures and as being house owners who also include the Dutch housing associations. For these housing associations, an additional covenant was created the Ministry of Spatial Planning and Environment in collaboration with the housing association sector. This covenant includes agreements on goals on energy saving improvements (Ministry of Internal Affairs, 2012). Within this covenant is mentioned that an average energy label B for the stock of a housing associations is the target in 2020. These ambitions are high and ask for solutions for the whole building stock of housing associations.

To increase the energy performance of their dwellings, housing associations perform sustainable renovation projects. In this research sustainable renovation is defined as:

“A renovation to transform an existing building to fulfil the requirements on the field of the energetic performance and the health and comfort of its users while achieving economic viability”

With sustainable renovation, housing associations are able to increase the energy performance of their dwellings. When a housing association wants to perform a renovation, it is stated by law that 70% of the tenants which have to deal with the renovation on which the project has an effect on the service costs and/or the rent have to give their permission (Hoppe et.al, 2008). According to a research performed by Atrienis (2012) the implementation of sustainable policies faces problems, with the result that the covenant goals are not reached. Even when the association has implemented an energy policy, they are not always convinced about meeting the goals. Several barriers were investigated and one of the main problems is that non-commitment of tenants and the intensive process to convince the tenants leads to delay or a stop of the sustainable renovation project. This research focuses on factors that influence this participation with the aim to improve the project plans of sustainable renovation projects in such a way that tenants are more willing to participate.

Research design

Assuming that the responsibility of convincing the tenants to participate in the sustainable renovation project lies with the housing association, this study had the aim to make statements about improving the project plan of these sustainable renovation projects. This is because this plan is the mean the housing association has to approach the project and on which the tenants react by participating or not participating. This leads to the following main question:

How can a sustainable renovation project be composed in order to encourage the tenants to participate?

To answer this question the research is designed as follows: the content of a sustainable renovation project will derived from literature study. Also the influential factors on tenant participation are based on literature study. This will lead to a preliminary statement on the influence of the project part on the tenant participation. Thereafter, the effect of the project

plan parts on the tenant participation according to the project leaders will be researched using applications of the Analytic Hierarchy Process.

The analytic hierarchy process (AHP), developed by Saaty (Saaty, 1980) is a popular decision support tools because of its powerfulness, simplicity, and potential of being utilized for a group decision-making process that involves multiple actors, scenarios, and decision elements (criteria, sub criteria and alternatives). The AHP requires a well-structured problem represented as a hierarchy with the goal at the top. The subsequent levels contains of criteria and sub criteria, while alternatives lie at the bottom of the hierarchy. The AHP determines the relative importance of set of (sub) criteria by employing pair-wise comparisons of the hierarchy elements at all levels following the rule that a given hierarchy level, elements are compared with respect to the element in the higher level by using a fundamental importance scale (Saaty, 1980). The AHP method is applied in construction projects in several ways, for example to find the best value-bid for a tender, to assess risks and uncertainties of construction projects or to determine the best project contracting approach. In this research, the hierarchy is structured with respect to the overarching goal: tenant participation.

After this an attempt will be made to forecast the effect of a project plan on the tenant participation by applying case studies as alternatives within the AHP. These results will be compared with the real participation of the tenants in these cases. The conclusions and statements derived from the research components lead eventually to recommendations on the content of sustainable renovation project plans with the aim to increase the tenant participation.

Sustainable renovation project plans

A project plan for sustainable renovations mainly consists of the technical improvements, financial calculations, tenant approach, and execution decisions. For each part, the housing association can make different decisions. The technical decisions consist of individual or communal energy saving improvements, possible supplemented by other maintenance or renovation work like kitchen renovation or a paint job. The financial decisions hold the pass of the investment costs to the rent for the current tenants and after mutation. This can be calculated as a percentage of the expected savings on the energy bill or as a percentage of the investment costs. It is also possible not to pass the costs to the rent for the current tenants. This can encourage the participation, but does not solve the problem of the split-incentive for the period until the current tenant moves. The split-incentive problem occurs when the investing party (the housing association) does not benefit from the financial revenue of the improvement (the tenants benefit from the savings on energy costs). Rent increase after mutation is often calculated on the basis of the increase of property value points. As an extra incentive, housing associations can provide an inconvenience fee as a compensation for the nuisance of the renovation.

In the project should be mentioned how the tenants are approached with the project plan. It is desirable that the communication is adapted to the type of tenants, for example when they are elderly or from foreign origin. The level of participation of the tenants within the renovation process can differ. It is possible that the tenants are only informed about the plans, that they are consulted, or that they have a say in the plans. Often, an interest group is composed at the beginning of the renovation process. The decisions concerning the

execution are globally described in a project plan, but often to a great extent left to the contracting party. The planning of the project and nuisance limitation are important aspects of the execution.

Tenant participation

The tenant participation in sustainable renovation projects depends on several factors. These factors belong to the tenant him or herself, the tenants' needs or the project content. This research states that the participation of a tenant is to a great extent dependent on the connection between the project content and the needs of the tenant. From literature the most important needs are described: understanding, benefit and nuisance limitation. When a tenant understands the project, how much benefit they want to have from the project or how much nuisance the tenant finds acceptable is dependent on the characteristics of the tenant and the level of resistance a tenant has. Also the project content has influence on the tenant participation. Thereof, the financial factors are considered to be the most important, especially the level of energy costs saving and the level of rent increase. The level of tenants say is also considered to be very important, in contrast to the other to aspects of the tenant approach: the frequency and type of communication. The most important aspects of the dwelling renovation (the lay-out improvement, improvement of the facility spaces and the improvement of the energy performance) are considered to be average important. The nuisance (duration, decrease of living convenience and preparatory activities) is considered to be less important. The most important criteria were thereafter schemed in a hierarchy model, shown in Figure 1.

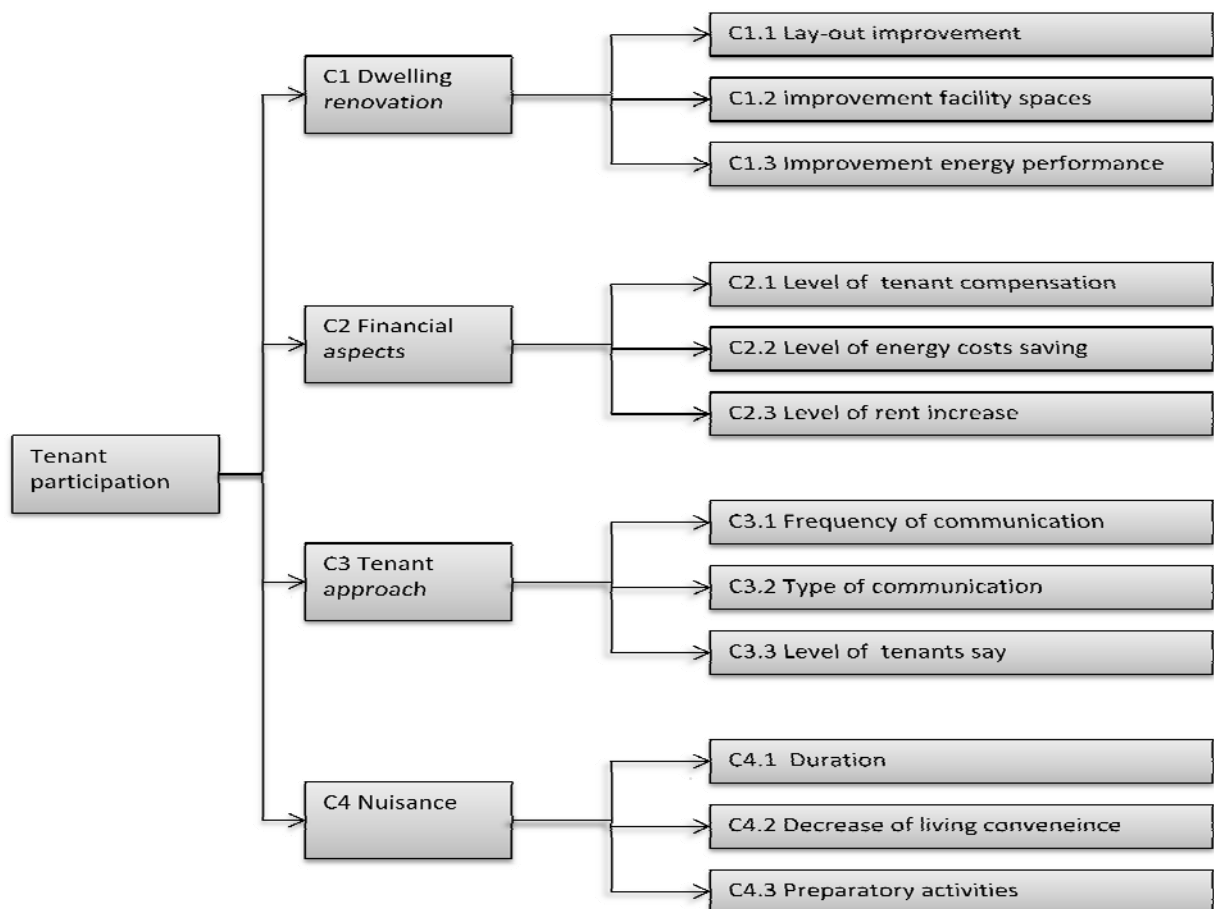
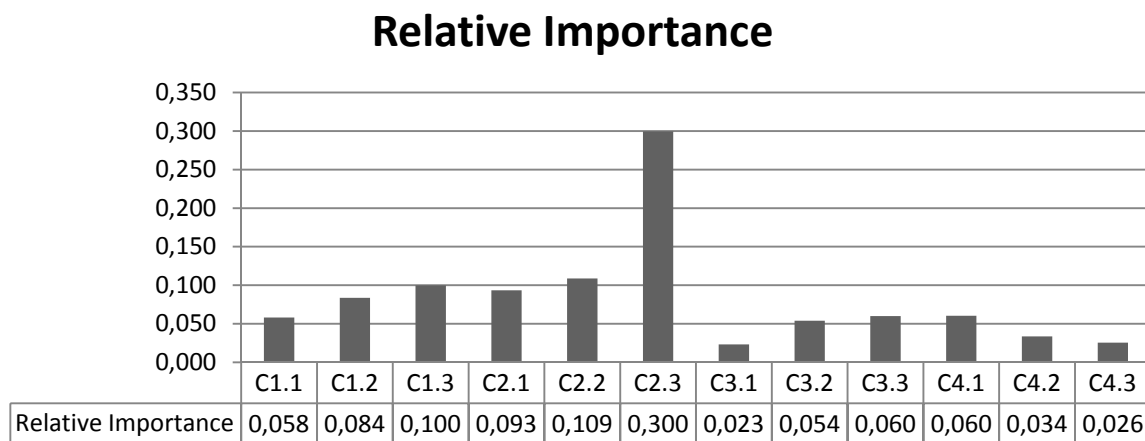


Figure 1 Hierarchy model of the influential criteria

To get the view of project managers on the influence of the project content on the tenant participation a survey was distributed among 125 project managers with experience in sustainable renovation projects. Within a period of two weeks, 36 project managers responded and their data was used for further analysis. A respondent consistency ratio of 15% was maintained which led to an exclusion of 14 of these 36 respondents. The design of the survey and the processing of the data are done on the basis of the AHP method.

According to the project managers, the financial factors are the most important aspects that influence the tenant participation. Thereof, the level of rent increase is the most important criteria. Next, the aspects of the dwelling renovation are considered to be important, with the improvement of the energy performance as most influential sub criteria. The tenant approach and the nuisance are considered to be less important. The most important sub criteria of those two criteria were the level of tenants say, the type of communication and the duration. The total result is shown in Graph 1.



Graph 1 Relative importance of the criteria

Striking was that there was a large diversity between the answers of the respondents. Therefore was tried to divide the respondents group into different groups and analyze the differences in outcome. The respondents group was divided on the basis of experience, housing association size and restructuring activities of the housing associations. The relative importance differed in all different divisions.

This difference in the three divisions led to two possible conclusions. The first is that there is a difference in the approach of 'older' and 'younger' project managers and the younger project managers focus more on the tenant approach. 'Older' and 'younger' is determined on the basis of experience years. The second is that project managers are influenced by the characteristics of the housing association they work for. When a certain criterion is important for a housing association, the project managers think that this is also an issue for the tenant, because this is an important focus within the process of the establishment of the sustainable renovation project. This can be a low budget and little possibilities to limit nuisance for small housing associations. The research shows that housing associations with less than 10.000 housing units or with relatively less money for restructuring activities think the financial aspects are more important to the tenant than larger or actively restructuring housing association. Also restructuring housing associations think that tenant attach more importance to the dwelling improvements than housing associations with less restructuring

activities. This is probably due to the fact that restructuring housing associations try more innovative and less conventional improvements causing the type of improvements to be more important.

Case application

In the research five cases were analyzed to investigate the possibility to calculate the score of the project plan content of the cases and link this score to the real tenant participation. Although the cases were quite diverse, the scores of the cases were very close to each other with normalized values between the 0.18 and 0.21. These scores found to be not correlated to the real tenant participation of the project cases. However, there were conclusions which could be drawn from the case studies.

The case with the lowest calculated score had a real tenant participation of 100%, and the case with the lowest participation (23%) turned out not having the lowest score. In both cases the real tenant participation could be explained by external influences. In the case with 100% participation the tenants were in favor of the sustainable renovation in advance. In the case with 23% participation a group of refusing tenants influenced the other tenants not to participate. This leads to the conclusion that a certain feeling within the group of tenants, for example resistance or a need for an improved dwelling has a major influence. The tenant participation rate in such case can be unrelated to the score of the project plan.

Another conclusion which can be drawn from the cases is that although the rent increase is states as being the most important criterion, people are willing to pay for a sustainable renovation. This is shown in all the cases and they had a varying rent increase from €7.60 up till € 92.50. Apparently, the benefits of the renovation project outweighed the possible negative aspects like nuisance. In the case with 100% participation the rent increase was even higher than the forecasted saving on energy costs. This was because of the improvements of the kitchen and balcony which matched the needs of the tenants.

Striking results

During the research, there were a few striking results. The interpretation of these results were discussed with experts a possible explanations for them were given.

First, the level of tenants say was substantiated from literature as a criterion with a high level of influence. But with a relative importance of 0.060 the high importance is not confirmed by the project managers. This difference can be explained in a few ways. The first explanation could be that the criterion is underestimated by the project managers or overestimated by the literature. Although in 4 of the 5 cases tenants had influence in the decision-making process, this influence was minimal. When a focus group had a vote in the contracting, this vote was too small to really make a difference. Also the possibility to choose the color of the paint for the window frames is not something which significant matters to the housing association. By an expert from Atriensis was confirmed that the voice tenants have in a sustainable renovation project is most of the time to give the tenant the feeling of influencing, but that this has a minimal effect on the content of the project plan. This could explain the difference in data: when the tenant has a vote in the decision-making process, the feeling of having a say is bigger than the real level of influence they have.

Second, although the influence of the level of rent increase was considered to be high according to both the literature as the project managers, the degree of importance is

disproportionately. It is striking that this aspect is of such a big importance because in every case the renovation has the goal to decrease the integrated housing costs for the tenant. A possible explanation for this is that in every project, the level of rent increase contributes to the decision and the other criteria do not play a role in every project. This does not mean that in one project, the level of rent increase is substantially more important, but that when all the experiences of the project managers are summed the level of rent increase plays overall the biggest role. Although the degree of importance is probably out of proportion, it is still the most important criterion. However, this does not mean that the higher the rent increase, the more difficult it is to convince the tenants to participate, but that the level of rent increase should fit the needs and ability of the tenants. At the end of a renovation the integrated housing costs are calculated to be lower than before the renovation, due to decreasing energy costs. So, why is the level of rent increase so much more important than level of energy costs saving?

The explanation is that the level of rent increase is fixed, and the calculated saving on energy costs is an estimation. Therefore it is a risk for the tenant to participate because the saving can be lower than estimated. It should be taken into account that for the tenants' feeling, the higher the level of rent increase, the higher the risk feeling. Moreover, most of the time the rent increase is applied soon after the renovation, while the advanced payment of the energy bill is decreased after a new calculation of the energy use, most of the time after a half year. For tenants of social housing with a low income, the rent increase can cause financial difficulties when the tenants do not benefit from the sustainable renovation immediately.

Recommendations

The research on the influential factors on tenant participation within the project content of sustainable renovations from literature and from project managers, in combination with case study, has led to recommendations. These recommendations have the aim to improve the project plans to persuade tenants to participate in a more effective way.

Understand, want, be able

The first recommendation is based on the conclusion that a project plan should focus on the tenants' needs. This means that tenants have to *understand*, *want*, and *be able to deal with* the sustainable renovation, in order to participate. This is shown in Figure 2 and is called the decision road. These three factors are goals which should be achieved by the project plan.



Figure 2 tenants' decision road

Every aspect of the project plan should follow the path of the arrows. Hereby, especially the financial factors should be taken into account. For a tenant, the total picture of the plan should fit also. The benefits should be in balance with the nuisance. Tenants are willing to pay for rent increase when on the other hand the benefits like a decrease of energy costs and increase of living comfort are present. When the housing association had plans for a building complex of which the tenants do not think they are immediately necessary, it is important to try to convince the tenant that it is important. In Table 1, tips are given to run through the decision road more successfully.

Table 1 Tips to run through the decision road

Understand	<ul style="list-style-type: none"> - Keep a clear structure of the information leaflets and letters - Do not use pretentious language - Create a low threshold for questions or comments from the tenant about the project
Want	<ul style="list-style-type: none"> - Argue from the problem of the tenant and show them the need for the improvement - Give the tenants the feeling they have a say - Be honest about the financial consequences and keep the financial risk for the tenant low - Invest in a good relationship between the tenant and the housing association - Show the improvements in a model dwelling
Be able to	<ul style="list-style-type: none"> - Match the financial risk with the financial circumstances of the tenant - Adapt the help to the tenants' characteristics and limit the nuisance - Work in one dwelling as short as possible - Guarantee the safety of the tenant and their property

Checklist

Although the project plans keep personalized reports, a procedure aiming at the implementation of the needs of the tenant helps improving the project plan. This is helpful because the project plan definitely has influence on the decision of the tenant to participate or not.

When a housing association wants to perform a sustainable renovation project and they need the participation of tenants, they have to keep in mind that it is their responsibility to convince the tenants. By presenting a checklist based on the findings of this research, project managers are helped to improve their project plan with the aim to get enough tenant participation in an efficient way.

Table 2 Project plan checklist

PROJECT PLAN CHECKLIST FOR THE PROJECT MANAGER	
Before intern	<ul style="list-style-type: none"> • What do you know about the tenants and their needs? • Make an inventory within the organization, what is the history of and experience with the building complex and their tenants? • Are limitations due to the tenant type, age, financial situation, young children, etcetera • To what extent do you want to involve the tenants? Is there already a residents committee?
Before extern	<ul style="list-style-type: none"> • Make an inventory via a survey to the tenant about the needs and complaints of the tenants • Is there a collective opinion among the tenants? • To what extent do the tenants want to be involved?
During the design	<ul style="list-style-type: none"> • Does the project plan match with the needs of the tenant? • What are the main subjects to communicate? <ul style="list-style-type: none"> - What are you going to do in the building complex, how long does this take? - What is the reason to do this renovation? - Why should tenants participate? - What is the result if they participate in terms of finance, living comfort and nuisance • Does the description fit on one paper? • Look again at the financial part <ul style="list-style-type: none"> - Is it clear that the tenant benefits from the renovation? - Is it understandable? - Is the rent increase adapted to the energy use of the household? Should it be? • Include a telephone number for questions
During the execution	<ul style="list-style-type: none"> • Use a focus group for (at least) consultation • Check if the tenants understand what is going on and what is expected of them • Be accessible for questions and comments • Be service oriented and help tenants when necessary • Ask afterwards if the tenants are satisfied

AKNOWLEDGEMENTS

This report would not exist without the help of the people who helped me with their knowledge, experience and time: my graduation committee Brano Blumac and Wim Schaefer from the Technical University Eindhoven and Linda Groenen from Atriensis. I would also like to thank the employees from diverse housing associations I interviewed and Luc Huveneers and Simon Reuvekamp for their time.

REFERENCES

Atriensis (2012) *Invoering energiebeleid door corporaties onder de loep*. Atriensis: Eindhoven

EnergyCouncil (2002) *Energy Performance Building Directive of the European Parliament and Council*, Energy Council: Manchester

Hoppe, T., Lulofs, K. (2008) The impact of multi-level governance on energy performance in the current Dutch housing stock. *Energy & Environment*, 19(6), 819-830

Ministry of internal affairs, Aedes, Woonbond, Vastgoedbelang (2012) *Covenant energie saving rental sector*

Saaty, T.L. (1980) *The Analytic Hierarchy Process*, McGraw-Hill: New York



S. (Susan) Reuvekamp

This summary is the result of my graduation thesis about tenant participation within sustainable renovation projects performed by housing associations. This research was done as completion of the master track Construction Management and Engineering at the Technical University in Eindhoven and in collaboration with Atriensis, a specialized consultancy firm. The research led to recommendations for housing associations to give substance to their project plans with the aim to efficiently convince tenants to participate in the renovation plans.

Feb 2013 – Aug 2013

Graduate intern, Atriensis

Sep 2011 – Aug 2013

Master Construction Management & Engineering,
University of Technology Eindhoven

Nov 2011 – Feb 2013

Assistant Safety, Health, Environment and Quality, Coolrec
van Gansewinkel group

Sep 2011 – Feb 2013

Certificate program Technology Entrepreneurship, Brabant
Center of Entrepreneurship

Sep 2010 – Aug 2011

Chairman and Students- and University PR board member,
Integrand Eindhoven

Feb 2009 – Feb 2010

Secretary/treasurer board member, students sorority

Sep 2006 – Aug 2013

Active member of the student union and participating in
diverse committees, SSRE

Sep 2006 – Aug 2011

Bachelor Architecture, Building and Planning, University of
Technology Eindhoven

BEWONERSPARTICIPATIE BIJ DUURZAME RENOVATIEPROJECTEN

De invloed van de projectinhoud op de bewonersparticipatie bij duurzame renovatieprojecten van woningbouwcorporaties, gebruik makend van AHP en case studie.

Auteur

S. (Susan) Reuvekamp

Afstudeerprogramma

Construction Management and Urban Development 2012-2013
Technische universiteit Eindhoven

Afstudeercommissie

Prof. dr. ir. Wim Schaefer (TU/e)
Dr. ir. Brano Glumac (TU/e)
Linda Groenen MSc. (Atrienis)

Afstudeerdatum

28 augustus 2013

Abstract

Dit onderzoek gaat over bewonersparticipatie bij duurzame renovatieprojecten, uitgevoerd door Nederlandse woningbouwcorporaties. Het is wettelijk verplicht dat 70% van de bewoners toestemming geven voordat het renovatieproject doorgang kan vinden. Echter blijkt dat deze toestemmingsgrens een probleem kan zijn wat leidt tot vertraging of een projectstop. In dit onderzoek is de invloed van de inhoud van het projectplan op de bewonersparticipatie onderzocht.

De belangrijkste conclusies waren dat een projectplan begrijpelijk, voordelig en binnen de mogelijkheden van de bewoner moet zijn. De belangrijkste factor hierin is het niveau van huurverhoging, ondanks dat het doel van het duurzame renovatieproject onder andere is het verlagen van de integrale woonlasten voor de bewoner.

Trefwoorden: bewonersparticipatie, integrale woonlasten, duurzame renovatie, bereidwilligheid tot participeren, woningbouwcorporatie, sociale huur

Introductie

In Nederland is het sinds enige tijd trend om de gebouwde omgeving energie zuiniger te maken. Deze trend is voortgekomen uit het aandeel van de gebouwde omgeving op de CO₂ emissie en stijgende woonlasten voor bewoners. In 2008 heeft de Nederlandse overheid het verplicht gemaakt voor huizenbezitters om een energielabel voor hun woningen te laten opstellen. Een energielabel laat de energieprestatie van een huis zien uitgedrukt in een letter: A voor zeer energie efficiënte woningen tot G voor zeer onefficiënte woningen. Daarnaast heeft de overheid in samenwerking met de sociale huursector een convenant opgesteld. In dit convenant is de ambitie uitgesproken om in 2020 een gemiddeld energielabel B te behalen voor de woningen in het bezit van Nederlandse woningbouwcorporaties. Om een verbetering in de energieprestatie van het hun huizenbezit te bewerkstelligen voeren woningcorporaties duurzame renovatieprojecten uit welke is gedefinieerd als:

Een renovatie om een bestaand gebouw te transformeren om te voldoen aan behoeftes op het gebied van energie prestatie, gezondheid en comfort voor de gebruiker terwijl er economische levensduurverlenging wordt behaald.

Wanneer een woningcorporatie een (duurzaam) renovatieproject wil uitvoeren is het wettelijk verplicht om toestemming van tenminste 70% van de bewoners te behalen. Hierna kunnen de overige bewoners worden gedwongen om ook mee te doen. Deze toestemming is nodig om werkzaamheden aan gezamenlijke installaties of ruimtes uit te kunnen voeren en om huurverhoging door te kunnen voeren naar aanleiding van investeringskosten en waardevermeerdering van de woning. De aanleiding van dit onderzoek is dat deze bewonersparticipatie niet altijd even gemakkelijk wordt behaald. Dit zorgt voor een vertraging of stop van het project. In dit onderzoek is gekeken naar factoren die de bewonersparticipatie beïnvloedden en de invloed van de inhoud van het projectplan. Dit is gedaan aan de hand van literatuurstudie, een enquête welke is verspreid onder ervaren projectleiders van duurzame renovatieprojecten en case studie. Dit alles met het doel aanbevelingen te doen aan projectleiders om het projectplan zo invulling te geven dat de bewonersparticipatie sneller wordt behaald.

Duurzame renovatieprojecten

Over het algemeen bestaat een projectplan uit de technische maatregelen, de financiële berekeningen, de bewonersbenadering en de uitvoeringsbeslissingen. Binnen deze aspecten kunnen verschillende keuzes gemaakt worden door de corporatie en de projectleider. De technische maatregelen bestaan uit individuele of gezamenlijke energie besparende maatregelen, mogelijk aangevuld met andere renovatie maatregelen zoals een nieuwe keuken op schilderwerk. De financiële worden doorberekend naar de huidige bewoner of na mutatie. De huurverhoging kan worden berekend als percentage van de besparing op energiekosten of als percentage van de investeringskosten. Voor de huidige bewoner kan ook geen huurverhoging worden berekend. Dit kan de bewoner aanmoedigen mee te doen met de renovatie, maar lost het 'split-incentive' probleem niet op. Dit probleem ontstaat wanneer de investerende partij (de corporatie) niet profiteert van de financiële opbrengsten (de huurder profiteert van de besparing op energiekosten). Hoe de bewoners benaderd worden en of de communicatie wordt aangepast aan de karakteristieken van de bewoner hoort ook in het projectplan. Evenals of en hoe de bewoners een bepaalde inspraak hebben in de plannen. Vaak wordt gebruik gemaakt van een bestaande of speciaal opgerichte bewonerscommissie. Verder wordt in het projectplan opgenomen hoe de uitvoering eruit komt te zien en welke maatregelen er worden genomen om de overlast voor de bewoner te beperken. Het is ook goed mogelijk dat een deel van dit laatste onderwerp wordt overgelaten aan de uitvoerende partij.

Bewonersparticipatie

Bewonersparticipatie bij duurzame renovatieprojecten hangt af van een aantal factoren. Deze factoren hebben te maken met de bewoner en zijn/haar karakteristieken, de behoeften van de bewoner of de projectinhoud. Uit literatuur blijkt dat de belangrijkste behoeften van de bewoner zijn het begrijpen van het projectplan, profiteren van de renovatie en limiteren van de overlast. In hoeverre bewoners behoefte hebben aan deze aspecten is afhankelijk van de karakteristieken van de bewoner.

Wanneer het gaat om de onderdelen van het projectplan dan zijn volgens de literatuur de financiële factoren het meest belangrijk. De financiële factoren bestaan uit een ongemakkenvergoeding, de besparing op de energierekening en de huurverhoging. Hiervan had duidelijk de huurverhoging de meeste invloed op de keuze van bewoners om wel of niet te participeren. Dit wordt bevestigd door de mening van de projectleiders. Het feit dat huurverhoging veel invloedrijker wordt bevonden dan de mogelijke besparing op de energierekening is te verklaren doordat eenhuurverhoging vaststaat voor een bewoner en een besparing een voorspelling is waardoor het een risico is of dit daadwerkelijk wordt behaald. Daarnaast wordt een huurverhoging vaak direct doorgevoerd terwijl een verlaging van het voorschot op energie pas na enkele maanden wordt doorberekend. Naast de financiële factoren bleek ook het type maatregelen (onderverdeeld in plattegrondverbetering, renovatie van keuken/badkamer en energetische maatregelen) van enig belang. Volgens de projectleiders zouden de aspecten van de bewonersbenadering (aantal communicatiemomenten, type communicatiemomenten en de inspraak van bewoners in de plannen) en de overlast-aspecten (duur van de renovatie, vermindering van leefgemak en benodigde voorbereidende acties) minder van belang.

Daarnaast bleek dat er een grote diversiteit onder de meningen van de projectleiders bestond. Naar aanleiding van een analyse waarbij de respondentengroep is opgedeeld in verschillende sub groepen gebaseerd op hun ervaring of karakteristieken van de corporatie waar ze voor werken, kon worden geconcludeerd dat projectleiders hun mening in de enquête deels baseerden op hun eigen focus. Bijvoorbeeld wanneer binnen een corporatie financiële aspecten zeer belangrijk zijn door een krap budget dan is de projectleider van mening dat de financiële aspecten ook voor de bewoner zeer belangrijk zijn.

Case studie

Uit de case studies kan worden geconcludeerd dat bewoners wel degelijk bereid zijn een huurverhoging te betalen wanneer er maar voldoende tegenover staat of wanneer de renovatie voldoet aan de behoeften en wensen van de bewoner. Daarnaast bleek dat wanneer er een gezamenlijke mening onder de bewoners heerst dit zoveel invloed op de participatie kan hebben dat de inhoud van het project ondergeschikt wordt. Dit kan zowel positief als negatief zijn. Het is dus belangrijk om als projectleider inzicht te hebben in de wensen en behoeftes van bewoners en van eventuele weerstand bij bewoners omdat de sociale invloed tussen bewoners groot is.

Aanbevelingen

Op basis van het onderzoek zijn aanbevelingengedaan om een projectplan zo in te richten dat deze aantrekkelijk overkomt voor de bewoner waardoor deze eerder participeert in het duurzame renovatieproject. Door een duidelijke structuur, begrijpelijke taal en een laagdrempelig vraagbaak is het plan voor ene bewoner begrijpelijk. Door de voordelen voor de bewoner duidelijk te maken, eerlijk te zijn over de financiële consequenties en risico's, bewoners het gevoel te geven dat ze inspraak hebben en te investeren in een goede corporatie-bewoner relatie willen bewoners eerder participeren. Daarnaast is het belangrijk hulp te bieden om de overlast voor de bewoners zoveel mogelijk te beperken.