Comparing (social) objectives for decision-making in housing associations

Bert Kramer, David Kronbichler* and Ton van Welie, Ortec Finance bv;
Jan Putman, de Alliantie

2006

Abstract

Housing associations are not after a financial gain but allocate (consciously if not unconsciously) a part of their available capital in order to achieve a range of social objectives. The real problem is that it is often very difficult to compare these objectives. Do we choose for an extra affordable house or do we spend more on livability? Answering these types of questions remains difficult as long as there is no objective way to compare the objectives.

This article describes a method to compare objectives using pairwise comparisons following Saaty's Analytic Hierarchy Process (AHP). With the help of the AHP objectives are ordered by importance and a weight-vector is determined. In order to use the AHP, we will have to choose an interval per objective with the minimum prerequisite level and the desired level. By using these intervals, it becomes possible to compare objectives measured in different units. This method can be used to support the decision making process at a Board level, but also to elaborate on the subobjectives at a district or regional level. Hereby, an optimal balance of allocated capital and the score of the objectives can be achieved at every decision making level.

Keywords: housing associations, social objectives, Saaty, transparency decision making.

* Corresponding author. Ortec Finance, Boompjes 40, Rotterdam, The Netherlands. E-mail: david.kronbichler@ortec-finance.com. The authors would like to thank Vincent Gruis for his comments on a previous version of the paper and Sijbrand Hofstra and Steven Korteland for gathering information.

Content

Introduction

Housing associations constitute the biggest group of players in the Dutch residential market, with around 2.4 million individual housing units owned. In the Netherlands, housing associations are non-profit organizations which are required to operate in the interest of housing. This is reflected in the Housing Act and the Social Rented Sector Management Decree (BBSH). The BBSH, which is established by the Dutch government, contains the rights and duties of Dutch housing associations[1].

In 1995, the Dutch government completely withdrew the direct financial support to the Dutch housing associations. As a consequence, the last decade the focus of Dutch housing associations has slowly become more outward looking, and more upon performance. They must achieve a return on their investment to finance future investment in new stock and urban renewal. Insight into this return is therefore indispensable in the evaluation of performance. The lack of information on their investment performance has hindered the extension of transparency in the market. Transparency is important not only for stakeholders, but also for the portfolio managers themselves. It enables the organizations to take better-informed decisions.

The increased demand for transparency is further illustrated by the current discussion on the supposedly excessive surplus capital in the Dutch social housing sector. The government and the public think that housing associations are very (or even too) wealthy, and that they should spend more on, for instance, urban renewal and on increasing the housing stock. Therefore, housing associations should be able to show how much capital they have available, what they plan to do with this capital, and whether they have excess capital.

To be able to answer these questions and to increase transparency, housing associations have to objectify their resource allocation decisions. Just like commercial organizations, housing association management is responsible for allocating resources in order to achieve the organization's purpose.

> ***"** In organizations, the decision-making function is the responsibility of management. In order to execute its responsibility, an organization's management requires information about the resources available to it and their relative effectiveness for achieving the organization's purpose. Resources are acquired, allocated, motivated and manipulated under the manger's control. They include people, materials, plant and equipment, money, and information. **"***
> (Churchman, cited in [7, p. 235])

The organization's purpose is attained through the achievement of multiple (often numerous, and competing) objectives. For housing associations, social objectives and financial restrictions will often be competing. An important question then is how a housing association rationally allocates its resources in order to achieve its goals.

[1] For a more thorough description of the Dutch social housing system and the role of housing associations herein, see for instance [8], [9], [10], [11], [19], [20] and [21].

Gruis [8] elaborates on the measurement of financial consequences of policies and how the risks involved in policies can be measured. There is no general methodology for the estimation of the social consequences. Gruis and Nieboer [10] forms an explorative study to the usage of performance indicators at housing associations in order to measure both financial and social return on investments. Gruis [9] discusses how financial and social returns can be measured in relation to asset management in Dutch housing associations. The author gives an overview of possible (social) performance indicators, but he does not try to compare or weigh these indicators. An explorative survey among Dutch housing associations indicates that, although housing associations collect a lot of data on social return, only a small minority really evaluate their performance by comparing their output against pre-set targets or benchmarks. Gruis [9] concludes that these results indicate that housing associations are not actively striving to use their financial surpluses in the interest of housing.

Thus, traditionally housing associations set financial targets and discuss social aspects, but they fail to set concrete targets for their social objectives which can be measured and evaluated properly (see also Gruis [9]). The problem is that objectives are often difficult to compare. How does an additional affordable house weigh against better livability? As long as these objectives cannot be compared objectively, this dilemma remains tough to resolve. This is mainly because the social objectives are often difficult to quantify. Moreover, if a quantitative measure does exist, there is often a large difference in the units of measurement between different objectives (for example, the number of affordable houses versus complaints from tenants). These differences prevent a straightforward comparison of the objectives. Perhaps this is the reason why the current decision-making process does not take into account the social objectives but only the financial objectives. Normally, an estimate of the financial consequences of a decision is available, no matter how uncertain these often are. On the other hand, people are much more reserved in estimating social consequences. Therefore, measuring social consequences usually occurs after the fact, if they are measurable at all.

The aim of this article is not to make every social objective measurable, but it does introduce a method that makes it possible to compare (social) objectives. This allows both the ability to actively involve social objectives in the decision-making process of associations, as well as increasing the possibility of more transparent management processes. We see the financial objectives in the methodology that we want to apply as the preconditions for the association as a whole, but not as the conditions for individual investment decisions. Therefore, we leave the financial objectives as they are and focus only on the social objectives. In the remainder of this paper, we first describe the methodology based on a theoretical example. Then we present a real-life case, and we end with the conclusions.

Methodology

To overcome the problem depicted above, we propose a methodology based on six concurrent steps:

1. Naming the objectives
2. Defining the objectives
3. Determining a score for the objectives
4. Weighing the objectives
5. Scoring the current policy
6. Optimizing the policy

We will now discuss these steps and work out an example.

1. Naming the objectives

In principle, housing associations distinguish two types of objectives. The first type is derived from the performance fields of the BBSH, while the second type is formed by the association's own social and portfolio objectives.

The six performance fields of the BBSH are:

1. Offering affordable housing for the target group
2. Keeping up the quality of the properties
3. Involving the tenants with policy and management
4. Guaranteeing financial continuity
5. Stimulating livability in neighborhoods and districts
6. Stimulating living and care

In our eyes, performance field number 4, guaranteeing financial continuity, is a precondition and not necessarily an objective. Housing associations may have specific objectives depending on the local housing market context. These include, but are not limited to:

1. More spacious homes
2. More homes for the mid to high income groups
3. More accessible homes
4. More homes in combination with good parking possibilities
5. More homes for the elderly
6. More homes for the young

For our example, we have chosen a typical mid-sized housing association that owns 8,000 units. Since the proposed methodology can be universally used for both BBSH and the associations' own objectives, we will use a limited set of – in this case both BBSH and non-BBSH objectives – to demonstrate the power of our concept. The objectives that we use in our example are very common for Dutch housing associations. The objectives given below have been used in a number of real life applications of our methodology. The objectives are:

- Offering affordable housing for the target group (affordability)
- Stimulating livability in neighborhoods and districts (livability)
- Involving the tenants with policy and management (customer satisfaction)
- More homes for the elderly (housing for the elderly)
- More homes for the young (housing for the young

2. Defining the objectives

It is important to establish a good and uniform definition of the objectives. For instance the terms 'affordability' and 'livability' are rather arbitrarily. Even within a single organization different definitions can co-exist. For adequate decision-making, it is imperative to achieve uniformity inside the association in terms of the definitions of the objectives.

In the previous paragraph 5 objectives were defined for our example. In order to use them later on, we will operationalize these as follows:

1. ***Affordability***; number of units where the net rent is lower than € 500 per month
2. ***Livability***; number of units where the score for livability is higher than 6 out of 10
3. ***Customer satisfaction***; number of customers who move into a unit who declare their satisfaction with a minimum of 7 out of 10
4. ***Housing for the elderly***; number of units without barriers and suitable for the elderly
5. ***Housing for the young***; number of units with rent lower than € 325 per month and suitable for the young

3. Determining a score for the objectives

When setting the objectives it is important to name the desired level (what score indicates that the objective is achieved), and at what moment the objective has to be reached. Doing this for all the objectives allows making a comparison between the objectives.

Because the units of measurement of the objectives that we want to compare are not equal, it is difficult to directly weigh them up against each other. Perhaps one finds an average livability score of 6.5 more important than realizing 5,000 affordable units, given the fact that there are already 4,500 affordable units. However, this would be different if there were no affordable units whatsoever. Therefore, what we need is the utility function for each objective. This utility function transforms the score for each objective to a value in the 0 – 1 range. However, it is very difficult to obtain utility functions in real life cases. Decision makers usually have difficulties in telling what their utility functions are. In our example we assume very simple utility functions. We define a unit per objective and set a desired level and a minimum level:

- ***Lower boundary*** = minimum required level, a lower score indicates that the objective has overall not been achieved (score = 0);
- ***Upper boundary*** = desired level, a higher score indicates that the objective has been reached completely (score = 1);

The score per objective is now determined as in figure 1 (see next page).

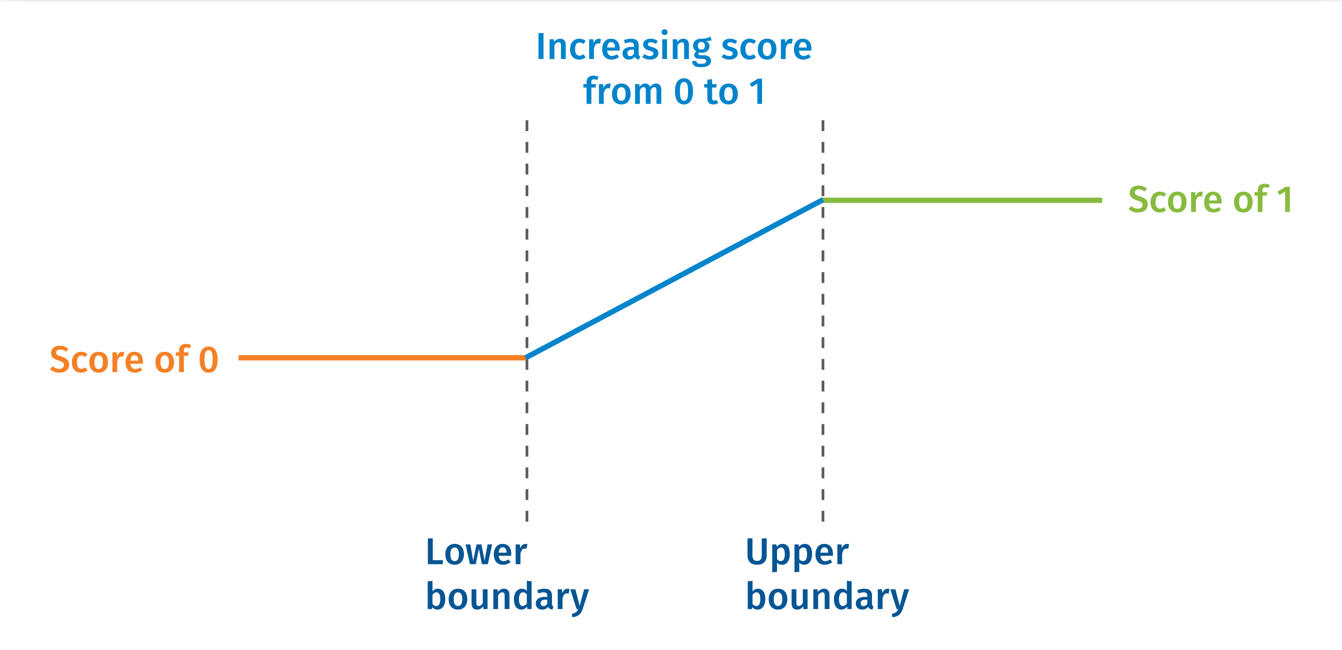

Figure 1: Utility function to determine a uniform score per objective

This means that everything achieved above the upper boundary does not count for the score of this objective. On the other hand, there is no penalization if you are far under the lower boundary. These utility functions have proven their use in practice, see the real-life case later in this paper[2]. However, for some cases they are probably too simple. In that case, it is possible to allocate more boundaries, which will extend the scoring possibilities.

For our example, we want to achieve the following boundaries in a period of 10 years:

1. Affordable housing	: 5,000	–	6,000 units
2. Livability	: 5,500	–	7,000 units
3. Customer satisfaction	: 3,000	–	4,000 customers
4. Housing for the elderly	: 200	–	800 units
5. Housing for the young	: 100	–	500 units

[2] BThe utility functions used in our approach are quite similar to the points scoring system applied by Hemphill *et al.* [12] to measure the performance of a number of indicators of sustainable urban regeneration. The authors use a 0-10 scale to measure the contribution to sustainability. Below the minimum level, the score is 0 and above the optimum or maximum level the score is 10 points. The main difference with our approach is that we assume a continuous function, whereas Hemphill *et al* assume a stepwise discrete function for most indicators: 6 intervals are defined with 0, 2, 4, 6, 8 and 10 points respectively. The intermediate intervals have equal width, which implies that essentially they are assuming a linear relationship. In [13] the same authors use the weighted sum of these indicators to compare urban regeneration projects in three European cities.

4. Analytic Hierarchy Process

In order to get a firm understanding of the following two steps of our proposed methodology, it is wise to first pay attention to the underlying methodology of Saaty's Analytic Hierarchy Process (AHP). The AHP restructures the decision-making problem hierarchically and by using pairwise comparison the ratios between the objectives are determined. The AHP uses this input to generate a weight vector that reflects the priority of each objective. This enables to grade various policies.

The basic problem with the decision making process for for example housing associations is that the features of the (multi criteria) objectives tend to have different dimensions; so called incommensurability [3]. The problem is that if you fail to address the differences in dimensions, you fail to use a methodological sound method, which may result in an invalid result. Various alternative methods to AHP have the same overall objective (for example multi attribute utility theory [3]) yet they tend to fail to effectively deal with this incommensurability. The approach of using hierarchical structuring and pairwise comparisons is not sensitive to this shortcoming. Examples of this approach include so-called outranking approaches and Saaty's AHP [3]. The outranking approach is a reaction on Saaty's AHP, as there are different insights on the underlying concepts of AHP [22]. However, the presented alternative is not as straightforward as AHP, nor is it clear whether the outranking approach actually performs better in the end.

The AHP is the product of Saaty's effort to create a straightforward procedure to deal with complexity. One of the strengths of the AHP is that it relies closely on a strategy that humans often use to deal with complexity: *"the hierarchical structuring of complexity into homogeneous clusters of factors"* [6]. This basis of the AHP ensures a transparent decision making process, something that – as was stated in the introduction – is increasingly important for housing associations and other organizations. This is an advantage for both external parties as well as for the decision makers themselves.

The final phase in the AHP (after hierarchical structuring and the analysis) is formed by a synthesis function. In complex situations humans tend to have difficulty to synthesize many elements intuitively. Using the AHP methodology this shortcoming can be compensated. The AHP closes the gap between the human ratio, and a mathematical method for the synthesis of this subjective information in the form of the objectives. This gives rise to both popularity of and criticism on the AHP.

Although there is a discussion amongst scientists on the theoretical validity of the AHP, the number of successful real life applications is very large. Just [5] already returns over 1400 references regarding AHP. A general overview on cases in various branches can be found in Zahedi [28]. Ball and Srinivasan [2] use the AHP for house selection. Their model allows the buyer to consistently evaluate property attributes. A recent application of this method to the field of commercial property investment can be found in Adair, Hutchinson and Leheny [1]. At this stage we will return to our methodology and our case. Some side notes on the usage of the AHP can be found in appendix III. For a more thorough description of the theory behind the AHP Saaty [23] [25] can be consulted or [7].

5. Weighing the objectives

The next step in our methodology is to rank these objectives based on their relative importance. We do this by assigning a value between 0 and 1. The sum of the weight factors adds up to 1. With five objectives, the average weight is 1/5. If a weight factor for a particular objective is higher than 0.2 it is more important than the average objective. If it is lower, the objective is less important than the average objective.

Comparing objectives

We assign a value between 1 and 9 to each objective D_1 that we are comparing with another objective D_2. These values represent the following value judgment:

- 1 if the two objectives have the same importance
- 3 if D_1 is a little bit more important than D_2
- 5 if D_1 is more important than D_2
- 7 if D_1 is much more important than D_2
- 9 if D_1 is absolutely more important D_2

We use the inverse of the above for judgments when the first objective is less important than the second objective. Thus:

- 1/3 if D_1 is a little less important than D_2
- 1/5 if D_1 is less important than D_2
- 1/7 if D_1 much less important than D_2
- 1/9 if D_1 is absolutely less important than D_2

The pairwise comparison matrix

We can process the comparisons of the objectives in a matrix. The columns and rows are the five objectives. If we compare objective i with objective j the resulting value would appear in the matrix in row i, column j. Note that the main diagonal will always be '1' as you are then comparing an objective with itself. To keep it simple, we will assume that only the filling of the upper triangle matrix has occurred. The values in the bottom triangle matrix are equal to the inverse (1 divided by the value) of the values in the upper triangle matrix.

Our matrix would then be equal to:

	Affordability	Livability	Customer satisfaction	Housing the elderly	Housing the young
Affordability	1	5	7	7	9
Livability	1/5	1	3	5	5
Customer satisfaction	1/7	1/3	1	1	3
Housing the elderly	1/7	1/5	1	1	5
Housing the young	1/9	1/5	1/3	1/5	1

Table 1: Pairwise comparison matrix

It is possible to let different people fill in the matrix and then generate a compiled matrix with values that are the average of the individual matrices. For simplicity, we will only use one matrix in our example.

The next step is formed by determining the principal eigenvector of the matrix with the use of pairwise comparisons. When the AHP was developed, processing power of computers was limited and expensive. Because of this fact, in his book Saaty presents simple mathematical methods to determine the principal eigenvector. These approaches are still used in many papers in spite of the progress made in the availability of powerful computers. This paper uses a similar approach. Additionally, appendix II describes the calculation of the principal eigenvector with use of the computer program Matlab.

First, we will normalize the pairwise comparison matrix. This means that we take the sum of each column and then divide each element by the corresponding sum.

This leads to the following normalized matrix:

	Affordability	Livability	Customer satisfaction	Housing the elderly	Housing the young
Affordability	0.36	0.74	0.57	0.49	0.39
Livability	0.13	0.15	0.24	0.35	0.22
Customer satisfaction	0.09	0.05	0.08	0.07	0.13
Housing the elderly	0.09	0.03	0.08	0.07	0.22
Housing the young	0.07	0.03	0.03	0.01	0.04
Total	1	1	1	1	1

Table 2: Normalized pairwise comparison matrix

To check if the matrix is consistent we can look at the normalized matrix. The fact that affordability has the highest value for all the columns shows that this matrix is quite consistent. Ideally, in a consistent pairwise comparison, each column of the normalized matrix would be the same. An in-depth check of the consistency of the matrix can be carried out. An example of this check can be found in appendix I.

Lastly, we use the average of every row as a weighting in the hierarchy of the objectives. Shown to the right are the weightings in order of importance.

By far, the most important objective is affordability, followed by livability. The least important is housing for the young.

	Weight
Affordability	0.56
Livability	0.22
Housing the elderly	0.10
Customer satisfaction	0.08
Housing the young	0.04
Total	1

Table 3: Weight vector

6. Scoring the current policy

The weight function gives a decent amount of information. Namely – what really is important for the organization and what is not. The question now is how do we include this weightings function in the decision making process. By using our example, we explain this further.

Named, in step 3, were the following boundaries of our objectives:

1. Affordability	: 5,000	–	6,000 units
2. Livability	: 5,500	–	7,000 units
3. Customer satisfaction	: 3,000	–	4,000 customers
4. Housing for the elderly	: 200	–	800 units
5. Housing for the young	: 100	–	500 units

With the current policy of the association, estimations of the realization of the objectives over a period of 10 years are:

1. Affordability	: 6,500 units
2. Livability	: 6,000 units
3. Customer satisfaction	: 3,500 customers
4. Housing for the elderly	: 320 units
5. Housing for the young	: 80 units

The following scores can then be determined:

1. Affordability	: 6,500, greater than 6,000	1.00 = 100%
2. Livability	: (6,000-5,500)/(7,000-5,500) =	0.33 = 33%
3. Customer satisfaction	: (3,500-3,000)/(4,000-3,000) =	0.50 = 50%
4. Housing for the elderly	: (320-200)/(800-200) =	0.20 = 20%
5. Housing for the young	: 80, less than 100	0.00 = 0%

The percentages above show how successful the achievement of the objectives was. However, in general people find it easier to compare results expressed in terms of grades than in percentages. We will therefore give each objective a number between 0 and 10.

This would lead to the following grades for the current example:

1. Affordability	: 10
2. Livability	: 3.33
3. Customer satisfaction	: 5
4. Housing for the elderly	: 2
5. Housing for the young	: 0

As explained in section 5, there is a difference in the importance of each of the weight factors. In order to express this difference, we multiply the scores with the weighting factors. **Below are the *weighed* scores:**

1. Affordability	: 5.60
2. Livability	: 0.73
3. Customer satisfaction	: 0.40
4. Housing for the elderly	: 0.20
5. Housing for the young	: 0.00

This makes the total "grade" of this association 6.93. In other words, given the current policy of the association and the weighting that they have given to the different objectives, they achieve a score of 6.93.

7. Optimizing the policy

In the example on the previous page, the association scores a grade of 6.93. The question is how we can improve this score for the association by using an alternative policy. Naturally many policy options can be thought up which would achieve a higher score for the association. For example, they can choose for a far greater investment in livability. As the objective is not completely at the desired level and the objective has a reasonably high value assigned, the score would then be much higher. However, it is not imperative that this option is chosen, as the alternative policy would also have financial consequences to consider. Every association would need to make a decision between the growth in score against the growth in cost. Overall, the aim would be an efficient policy variant. This is a policy variant where given the scores of the objectives the costs are as low as possible, or where given a specific cost level the scores for the objectives are as high as possible.

The association's resources are roughly equal to the value of its housing stock. There are different methods to value the housing stock. With some of these methods, the value depends upon the association's policy (i.e., the strategy chosen). This is undesirable in case different policies have to be compared (see [16]). Gruis [8] discusses several concepts of value and valuation methods for housing associations. He distinguishes two relevant values for housing associations: the income stream value and the market value for rented units. The market value for rented units is also used for the Aedex / IPD social housing property index (see [29]). The market value for rented units gives the maximum earning capacity of the housing stock. However, the actual policy of the housing association will almost always deviate from the assumptions made to obtain the market value because of the association's social objectives. Therefore, the income stream value is also important for a housing association.

The income stream value is the Net Present Value of:

- rental income according to the associations' rental policy;
- operating costs according to the associations' portfolio strategy;
- sales results according to associations' portfolio strategy;
- residual value according to the market.

The income stream value, therefore, is the resultant of the associations' portfolio strategy and not of the market. As the market value is independent of the associations' policy and the income stream value mirrors the expected value of the current policy, the difference between the two values is the "opportunity cost"[3] for the association. In other words, the costs the association has to make to realize their social objectives.

[3] Gruis[8] uses the term economic loss.

Suppose that in our example the market value is equal to € 700 million and the income stream value is € 200 million. Thus, the grade for the association is 6.93 and its associated (opportunity) costs are € 500 million. Thus, the association pays in fact € 72 million per 1 point in the score. The lower the costs per point in the score the more efficient the policy is[4].

The question is how to optimize the policy. Ideally an inventory is made of all the possible policy variants followed by an analysis of the costs and grades. In practice, this is not possible. There is an innumerable amount of policy variants and estimating the score and costs is labor-intensive. It would be more practical to take the current policy and systematically find better solutions.

A logical next step would be to divide the decision-making problem into subprojects (ie. on a regional level). This division can be enforced top-down, but it can also be the result of negotiations between, for example, regional teams. The described method can be applied to every division of the properties. This enables the possibility to match the division to the decision-making structure of the organization.

[4] This method of dividing the opportunity costs by the score in order to be able to compare different policies is comparable to the approach used by Ball and Srinivasan [2] to compare different houses in a house selection process. They divide the listed price of a house by the score for buying to obtain a common unit of comparison (the so-called "Attribute Weighted Price").

Real-life case

As stated before, the AHP is already being used in numerous branches. To show that the presented methodology does not only work in theory, we will now demonstrate the practical use by means of a real-life case. This case is taken from [14].

In 2005 one of the Netherlands' largest housing associations, Portaal, implemented an asset liability management strategy using the presented methodology. Leading in the process of naming and defining the objectives was the organization's general mission statement, divided into three elements:

- People who cannot afford to buy a house, should be given the opportunity to rent affordable housing;
- The tenants should be able to count on well maintained housing, in a livable environment where they feel at ease;
- Portaal takes extra care for certain groups, including mentally/physically challenged and homeless people.

This mission statement was then translated into a number of objectives. The first three objectives are based on Portaal's philosophy to ensure that a directly proportional share of the target groups should be accommodated. In figures 2 and 3 one can see the relative market shares of Portaal per income group per household type in two Dutch cities: Arnhem and Amersfoort. Three categories of income group per household type are determined; each based on a plural of the modal income[5] per household. It is clearly visible that in Arnhem and Amersfoort, Portaal meets, even exceeds, its goal when it comes down to housing for incomes of more than 1.5 modal per household and incomes of 1 to 1.5 modal per household of 1 to 2 persons. It is also evident that the goal is not met in Amersfoort for incomes below modal, and in Arnhem for family households in the category below 1.5 modal.

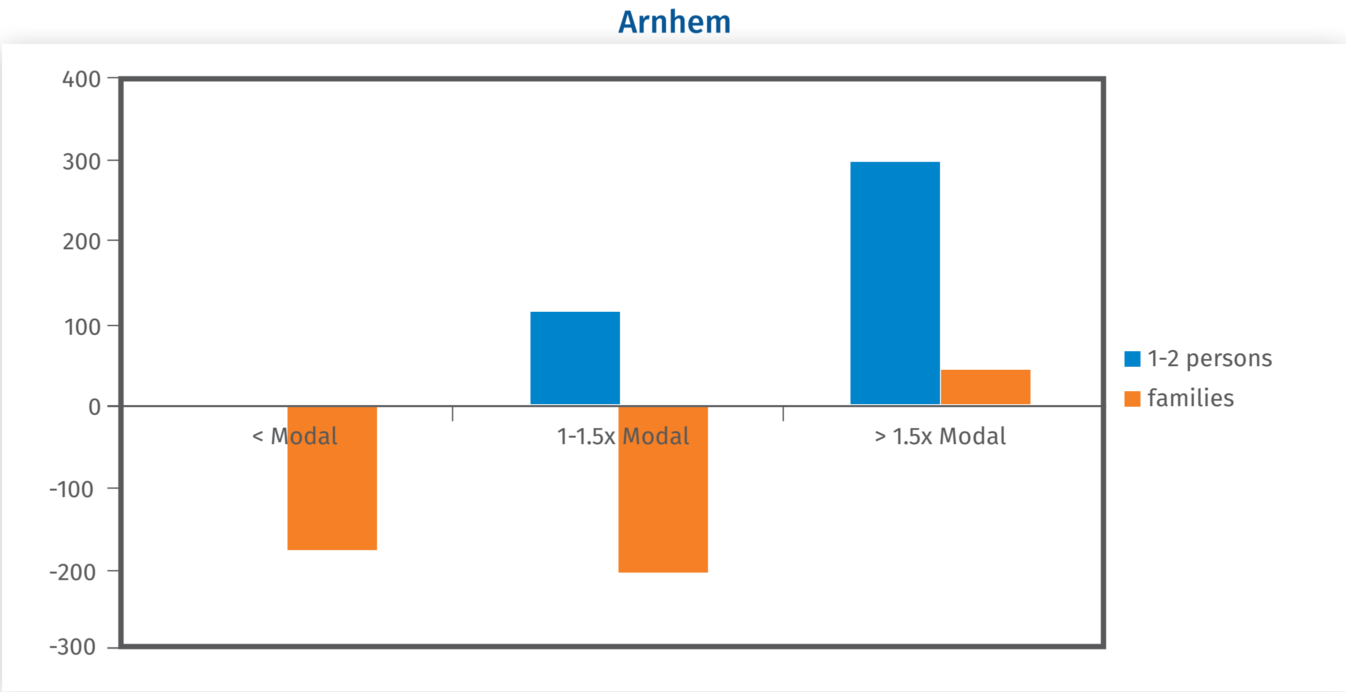

Figure 2: Relative market share of Portaal per income group per household type in the city of Arnhem

[5] The term modal income, or simply referred to as 'modal', refers to a commonly used gross income value in the Netherlands. Although the term may suggest something else, this term does NOT refer to the statistical modal. For 2005 the modal income was set to € 29.000, in this case Portaal uses a slightly higher level of € 30.000 (roughly $ 38.000).

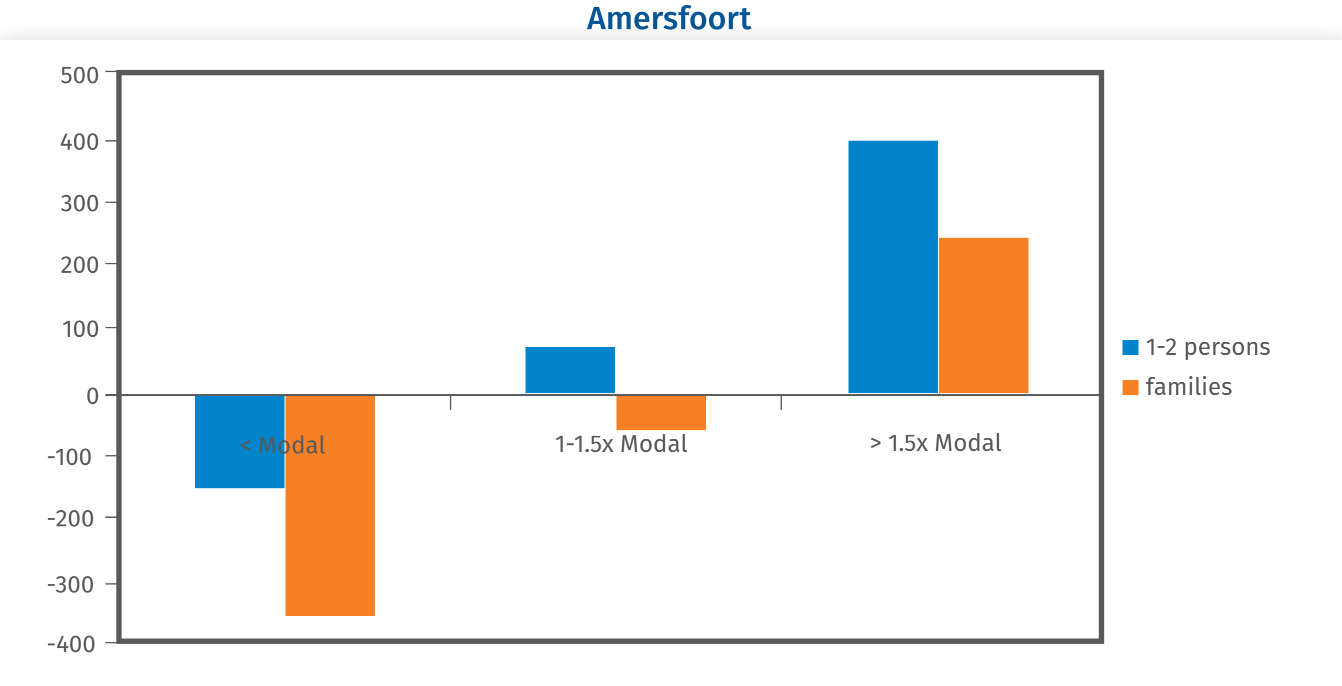

Figure 3: Relative market share of Portaal per income group per household type in the city of Amersfoort

Based on the findings in this first phase, Portaal has set six objectives for the period of 2007-2011. Please note that although only the data of Arnhem and Amersfoort have been discussed, these objectives are valid for the association in general.

1. Portaal strives to house at least a direct proportional share of the households with an income below modal in its operating area in 2011.
2. Portaal strives to house at least a direct proportional share of the households with an income between 1 to 1.5 times modal in its operating area in 2011.
3. Portaal strives to house at least a direct proportional share of the households with special needs in its operating area in 2011.
4. Portaal strives to achieve that 75% percent of their customers is satisfied with the quality of the housing and grades this aspect with at least a 7 out of 10 in 2011.
5. Portaal strives to achieve that 65% percent of their customers is satisfied with the quality of their neighborhood and grades this aspect with at least a 7 out of 10 in 2011.
6. Portaal strives to achieve that 70% percent of their customers is satisfied with the quality of the service and grades this aspect with at least a 7 out of 10 in 2011.

Of these six objectives, Portaal gives priority to the objectives for the lower income groups, the housing of people with special needs, and the customer satisfaction of the quality of the neighborhood. This prioritization is reflected in the table 4 on the next page.

Objective	Weight vector
Housing households below modal	0.32
Housing households 1 – 1.5 x modal	0.08
Housing households with special needs	0.23
Customer satisfaction: housing	0.13
Customer satisfaction: neighborhood	0.19
Customer satisfaction: service	0.07

Table 4: Portaal weight vector

Portaal has also set both upper and lower limits. The current achievements are seen as the lower limits; in other words, a new policy should not lead to a lower performance. The levels set in the six objectives for 2007-2011 are seen as the upper limits. A score of 10 would therefore indicate that all these objectives are completely realized. A score of 0 would indicate that the performance in 2011 is lower on all six objectives compared to today.

Before the effects of different policies can be determined, first the current policy has to be analyzed. Based on annual customer satisfaction surveys and on external resources Portaal can determine what the effects are of their current policy. In this section we will specifically look at the situation of the performance of Portaal in the city of Leiden. With the current policy, the customer satisfaction for the neighborhood is expected to rise from 57% in 2005 to 62% in 2011 (see objective 5). In order to reach the ambition of 65% of all customers satisfied with the neighborhood, Portaal has come up with the idea of upgrading a certain housing estate near the city centre of Leiden, including an upgrade of the surrounding area. It is expected that this upgrade will increase the customer satisfaction of the neigborhood. The extra investment is likely to be returned by means of an increase in the rent per property. In table 5 two policies are depicted: the current policy in which the upgrade is not included, and the alternative policy in which it is included.

Objectives	Current policy (2007-2011)		Alternative policy (2007-2011)	
Estate				
Customer satisfaction neighborhood	50%		75%	
Customer satisfaction housing	65%		100%	
Portaal Leiden		**Score**		**Score**
Households below modal	1.500	8	1.500	8
Households 1 – 1.5 x modal	1.500	10	1.500	10
Households with special needs	250	7	250	7
Customer satisfaction: housing	73.0%	6	73.5%	7
Customer satisfaction: neighborhood	62.0%	4	62.5%	5
Customer satisfaction: service	70%	10	70%	10
	Total:	**7.21**	**Total:**	**7.53**

Table 5: Comparing the performance of the current and alternative policy

This analysis clearly shows the difference between these policies. In the alternative policy "customer satisfaction: neighborhood" still falls short of the upper limit of 65%, but the total effect is marginally better than the current policy.

Determining a new policy is also a question of analyzing the financial aspects. In table 6 the financial consequences of both policy variants are depicted.

	New policy	Alternative policy
Market value	€ 400 million	€ 400 million
Income stream value	€ 350 million	€ 349.8 million
Opportunity costs	€ 50 million	€ 50.2 million
Objective score	7.21	7.53
Costs per unit score	€ 6.93 million	€ 6.67 million

Table 6: Financial consequences of the current and alternative policy

In this case, not only does the alternative policy perform better on the social objectives, but also the costs per unit score are lower. The alternative policy will therefore be implemented.

Portaal has the intention to use this method again for future investment decisions.

Conclusion

In this paper we have described a methodology to determine the importance of social objectives. By using the pairwise comparison method, we have created a weighting between the different objectives. The resulting weight vector made it clear which objective of the association is the most important.

For the association as a whole it was determined to which degree the set target was met. This resulted in a score per objective, which in turn can be multiplied with the weight factor of the appropriate objective. The summed up score attaches a grade to the current policy of the association.

For the decision making process of the association, it is of importance to keep in mind how a change in the policy can effect the total score. With this, people are continually seeking for a more efficient policy. That is not only a policy that leads to a higher grade. We must also take the costs of the policy into account. A policy can be called efficient when the ratio between the score and the cost is as high as possible.

In order to achieve a more efficient policy the association will have to, step-by-step, find and analyze alternative policy variants. If an alternative policy offers a favorable effect on the score / costs ratio, the new policy can be implemented. To get to an efficient policy variant quickly, it is crucial to use employees with as much knowledge of the properties as possible. On a local level, employees can get to efficient solutions by splitting the objectives and the costs of the association as a whole (consider it a large project) into sub-projects. The explained methodology ensures that the total score of the association also improves.

The proposed methodology makes it easier to compare social objectives with other social objectives and with financial objectives. However, it remains tough to determine what the exact effect is on a social objective if an X amount of cash is spent. The number of houses for the elderly is an example of a social objective in which the relation investment versus expected performance is evident. The term livability on the other hand is a bit more complex. The authors wish to stress the following two points. Firstly, it is important to operationalize (especially social) objectives in unambiguous performance indicators. Secondly, the power of the proposed methodology lies not in pure one-on-one relations between the financial investment and the social and financial results. Much more important is the power of our concept as a sensitivity analysis (i.e. what is the overall effect if more attention is paid to objective A than to objective B or C and vice versa).

Reference list

[1] Adair, A.S., Hutchinson, N.E., Leheny, I. (2004) *The reporting of risk in real estate appraisal: Property risk scoring*. Paper presented at the 11th European Real Estate Society Conference, June 2004, Milan, Italy.

[2] Ball, J., Srinivasan, V.C. (1994) Using the Analytic Hierarchy Process in House Selection, *Journal of Real Estate Finance and Economics*, 9: pp. 69-85.

[3] Bergh, van den, J.C.J.M., Ferrer-i-Carbonell, A., Munda, G. (2000) Models of Individual Behaviour and Implications for Environmental Policy, *Ecological Economics*, 32(1): pp. 43-61.

[4] Belton, V., Gear, T. (1983) On a short-coming of Saaty's method of analytic hierarchies, *Omega*, 11(3): pp. 28–30.

[5] Expert Choice, http://www.expertchoice.com/ahp/ AHP Reference Partial Listing (last visited on April 5th 2006).

[6] Forman, E.H., Gas, S.I. (2001) The Analytic Hierarchy Process – An Exposition, *Operations Research*, 49(4): pp. 469-486.

[7] Forman, E.H., Selly, M.A. (2001) *Decision by Objectives*. World Scientific. Available, but not publicly on: https://www.worldscientific.com/worldscibooks/10.1142/4281#t=aboutBook

[8] Gruis, V.H. (2002) Portfolio Management in the Social Rented Sector: Valuation, Risk Analysis and Strategy Development, *Housing Studies*, 17(2): pp. 245-265.

[9] Gruis, V.H. (2005) Financial and social returns in housing asset management: Theory and Dutch housing associations' practice, *Urban Studies*, 42(10): pp. 1771-1794.

[10] Gruis, V.H., Nieboer, N. (2004) *Financial and Social Return in Housing Asset Management, Theory and Practice of Dutch Housing Associations*. Paper presented at the ENHR Conference, July 2nd – 6th 2004, Cambridge, UK.

[11] Gruis, V. and Nieboer, N. (2004) The Netherlands, in: V. Gruis and N. Nieboer (Eds) *Asset Management in the Social Rented Sector: Policy and Practice in Europe and Australia*, pp. 185-208. Dordrecht: Kluwer Academic Publishers.

[12] Hemphill, L., Berry, J., and McGreal, S. (2004) An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 1, Conceptual Foundations and Methodological Framework, *Urban Studies,* 41(4): pp. 725-755.

[13] Hemphill, L., Berry, J., and McGreal, S. (2004) An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 2, Empirical Evaluation and Case-study Analysis, *Urban Studies*, 41(4): pp. 757-772.

[14] Hoesel-Snel, B. Van, and R.J. Spits (2006) Asset liability management in de praktijk [Asset Liability Management in practice], Compact 27: *Presteren met vermogen, de corporatie als maatschappelijk belegger* [Performing with capital, the corporation as a social investor]. Hilversum: Aedes, May 2006, pp. 22-30.

[15] Holder, R.D. (1990) Some comments on the analytic hierarchy process, *The Journal of the Operational Research Society*, 41(11): pp.1073–1076.

[16] Kramer, B., Welie, van, T. (2004) *Towards optimal housing management: Allocating capital to social objectives*. Paper presented at the ENHR International Housing Conference, July 2004, Cambridge, UK. For a copy of this paper please contact the authors.

[17] Lootsma, F.A. (1990) *A multiplicative variant of the analytic hierarchy process*. Delft University of technology, Technical Report 90-45, Reports of the Faculty of Technical Mathematics and Informatics.

[18] Miller, G.A. (1956) The magic number seven, plus or minus two: Some limits on our capacity for processing information, *The Psychological Review*, 63, pp. 81–97.

[19] Priemus, H. (1996) Recent changes in the social rented sector in the Netherlands, *Urban Studies*, 33, pp. 1891-1908.

[20] Priemus, H. (2001) Social housing as a transitional tenure? Reflections on the Netherlands' New Housing Memorandum 2000-2010, *Housing Studies*, 16, pp. 243-256.

[21] Priemus, H. (2003) Social housing management: concerns about effectiveness and efficiency in the Netherlands, *Journal of Housing and the Built Environment*, 18, pp. 269-279.

[22] Roy, B. (1991) The Outranking Approach and the Foundations of ELECTRE Methods, *Theory and Decision*, 31, pp.49-73

[23] Saaty, T.L. (1980 *The Analytic Hierarchy Process*. McGraw Hill. Reprinted by RWS Publications, Pittsburgh, 1996.

[24] Saaty, T.L. (1984) The legitimacy of rank reversal, *Omega*, 12(5), pp. 513–516.

[25] Saaty, T.L. (1986) Axiomatic foundation of the analytic hierarchy process, *Management Science*, 32(7), pp. 841–855.

[26] Triantaphyllou, E. (2001) Two new cases of rank reversals when the AHP and some of its additive variants are used that do not occur with the multiplicative AHP, *Journal of Multi-criteria Decision Analysis*, 10, pp. 11–25.

[27] Warren, L. (2004) *Uncertainty in the analytic hierarchy process*. Technical Report DSTO-TN-0597, Australian Government Department of Defence. Command and Control Division Information Sciences Laboratory.

[28] Zahedi, F. (1986) The analytic hierarchy process a survey of the method and its applications, *Interfaces,* 16(4), pp. 96–108.

[29] www.aedex.nl. This site contains all information regarding the index and the appraisal protocol. Not available anymore. Aedex has been acquired by IPD.

Appendix I: Check for Consistency

In this appendix, we go deeper into testing the consistency of the pairwise comparison matrix. This is quite important for the 'garbage in, garbage out' principle. If the matrix were not consistent, deriving sensible conclusions would not be possible. For a more comprehensive foundation, see chapter 4 in Forman & Selly [7].

We call the amount of different objectives n. We call the pairwise comparison matrix A and the weight vector w. First, we multiply this $n*n$ matrix A with the $n*1$ weight vector, $A*w$. In our example:

A:

	Affordability	Livability	Customer satisfaction	Housing the elderly	Housing the young
Affordability	0.36	0.74	0.57	0.49	0.39
Livability	0.13	0.15	0.24	0.35	0.22
Customer satisfaction	0.09	0.05	0.08	0.07	0.13
Housing the elderly	0.09	0.03	0.08	0.07	0.22
Housing the young	0.07	0.03	0.03	0.01	0.04
Total	1	1	1	1	1

w:

Affordability	Livability	Customer satisfaction	Housing the elderly	Housing the young
0.56	0.22	0.08	0.10	0.04

Aw:

Affordability	Livability	Customer satisfaction	Housing the elderly	Housing the young
3.25	1.25	0.45	0.49	0.19

Next, we calculate the eigenvalue λ using $\frac{1}{n}\sum_{i=1}^{n}\frac{\text{element i from A * w}}{\text{element i from w}}$.

In our example: λ = $\frac{1}{5}$ * 27.0271 = 5.4054

The eigenvalue in a fully consistent filled in matrix is equal to the sum of the diagonal elements of the matrix (the trace of the matrix), or n. Therefore, we can use the difference between λ and n as an inconsistency criterion. Furthermore, λ is always greater than or equal to n.

We now calculate the consistency index (CI) as $CI = \frac{\lambda - n}{n-1}$

In our example that would be $CI = \frac{5.4054-5}{5-1} = \frac{0.4054}{4} = 0.1014$

Eventually we use the CI to see if A is consistent (enough).

We use the following criterion:

If $CI = 0$ then A is consistent
If $CI / RI_n \leq 0.10$ then A is consistent enough
If $CI / RI_n > 0.10$ then A is reasonably inconsistent
The 'random' index RI_n is the averaged value of CI for arbitrary chosen values of A (given that the values on the main diagonal are 1 and the below triangle matrix is the inverse of the above triangle matrix). For n objectives RI_n is given by:

n	2	3	4	5	6	7	8	9	10	...
RI n	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.51	..

In our example that would be $CI / RI_5 = \frac{0.1014}{1.12} = 0.0905$

This is smaller than 0.10 and therefore sufficiently consistent. Therefore, we can see that the weight-function is reliable and we can use it for further analysis.

Appendix II: Principal Eigenvector

The weight vector of the AHP as described by Saaty [23] is generated by the principal eigenvector. In the example in this paper an estimation is used. The real principal eigenvector calculated with the use of Matlab is:

	Weight
Affordability	0.58
Livability	0.22
Housing the elderly	0.08
Customer satisfaction	0.09
Housing the young	0.03
Total	1

Table A1: Principal eigenvector

The approach used in this paper closely matches the real principal eigenvector. Remarkably the rank has changed. The cause for this shift probably lies in the fact that 'Housing the elderly' and 'Customer satisfaction' have a very similar weight. This can cause a shift in rank when different methods are used to determine the eigenvector. One should always take the differences between the weights into consideration, and not only the ranking. A statement like one objective is more important than another while the difference in weight is very small, is not tenable.

Appendix III: Critique on the usage of AHP

The authors do not pretend to give a complete overview of the critiques on AHP. In this appendix only the most relevant issues will be mentioned, including a reference for background information.

First of all, the theory behind the AHP is based on a set of axioms (a more extensive definition of these axioms and the theory can be found in Saaty [24]). In Warren [27] the authors question if the axioms are backed up by an adequate mathematical foundation. For instance, the axioms would be unsuitable to function as required and sufficient preconditions for a mathematical method.

Secondly, the AHP uses a system in which semantic statements for pairwise comparison of objectives are translated to numerical ranks. The ranking system in this paper/article refers to the original ranking system introduced by Saaty (the development of the original system is described in Saaty [23]). A paper from the field of psychology by Miller [18] has played an important role in the development process. It is perhaps useful to take into consideration the critique on Miller by Holder [15]. One important element of this critique is formed by the friction between the psychological aspects and the numerical interpretation. In the case of AHP, it allows a certain degree of inconsistency and transitivity – which is correct from a psychological point of view - that could lead to numerical discrepancies.

Another source of critique on the original AHP is the phenomenon of rank reversal [15]. Rank reversal refers to the shift in rank of alternative objectives each time the problem is evaluated on a different basis or when small changes occur (for instance when a very similar objective is added to the list). This phenomenon was first reported by Belton and Gear [4]. Belton and Gear noticed that whenever an alternative, yet very similar objective was added, rank reversal occurred.

The cause of this form of rank reversal should be sought in the normalization of columns in the matrix. Belton and Gear therefore propose to divide the column elements by its largest value. This version of the AHP was later accepted by Saaty and is being referred to as ideal mode AHP. However, Saaty [24] has shown that *ideal mode AHP* is also sensitive to rank reversal.

In Triantaphyllou [26] a case study is used to research more forms of rank reversal. [26] shows that rank reversal occurs when ideal mode AHP is applied. Saaty [24] also points out that rank reversal, although contra-intuitive, is not uncommon in real-life. When the problem is multidimensional, the multiplicative AHP can provide a solution in order to prevent rank reversal (Lootsma [17]).

In this paper the original AHP is used. In our current application, there will be no evaluation of sub-problems. However, if in a later stage the structure becomes multidimensional (when objectives are split up in sub-objectives), the multiplicative AHP can be used. This will prevent rank reversal from occurring. However, for our current application even when rank reversal occurs this should not be too problematic.

The final remark refers to the translation of pairwise comparisons to weight vectors. Over the years various methods have been developed for the synthesis of the matrix with scores in order to create the weight vector. According to Saaty the principal eigenvector is the appropriate weight vector for the matrix with pairwise comparisons. To this day no consensus exists regarding which method best describes the appropriate weight vector. For an overview of alternative methods for determining a weight vector Zahedi [28] can be used. This paper also deals with the different criteria that are proposed for the evaluation of these alternatives.

As stated before, this is not a complete list of all critique. A recent report that elaborates on the critique on the AHP is Warren [27]. In this report virtually all important scientific papers published on the field of AHP are reviewed. Warren concludes that one should be careful while implementing the AHP, as the AHP has a number of questionable characteristics. Especially the validity of the ratio scale assumption is questionable. To conclude, there is a discussion amongst scientists on the theoretical validity of the AHP. In spite of this, the number of successful real life applications is very large. The AHP has proven its relevance in practice.

More information?

If you have any questions regarding this article contact the authors via the contact details below.

Bert Kramer
Head of Climate Research, Climate & ESG Solutions
+31 10 700 56 47
bert.kramer@ortec-finance.com

David Kronbichler
Managing Director
+31 10 700 56 44
david.kronbichler@ortec-finance.com

Ton van Welie
Chief Executive Officer
+31 10 700 50 00
ton.vanwelie@ortec-finance.com

Disclaimer

Please note that this report has been prepared with care using the best available data. This report may contain information provided by third parties or derived from third party data and/or data that may have been categorized or otherwise reported based upon client direction. This report is not intended as an investment advice. Ortec Finance assumes no responsibility for the accuracy, timeliness or completeness of any such information. Ortec Finance accepts no liability for the consequences of investment decisions made in relation on information in this report.

contact@ortecfinance.com | www.ortecfinance.com

Rotterdam | Amsterdam | London | Toronto | Zurich | Melbourne | New York