A decision support system for housing management.

Towards an integration of object related technical, commercial and financial data.

Jos Smeets
Stephan Maussen
Eindhoven University of Technology
Faculty of Architecture, Building and Planning
Department of Town Planning
Eindhoven

ABSTRACT

The paper deals with the decision making process in relation to housing management. The DSS was developed in favour of several Dutch housing association and has been implemented in their organisation. For the purpose of strategic management the developed system includes an integration of object related technical, commercial and financial data.

Firstly we enter on the context in which decision making takes place. Then we will make some remarks on strategic housing management. Thirdly we go into the data input of the Decision Support System.

The following conditions are used in a 'decision table':
- a Rentability Index (RI)
- the trend in the RI
- the tenant's appreciation
- the intended target group
- the investment policy
- the possibility to increase the rent

Based on these conditions the most appropriate strategy has been selected as output. The output also shows the urgency of a problem.

The developed DSS-system supports decision making on the level of dwelling estates as well as on the level of the whole portfolio. This paper has been confined to DSS on the level of a dwelling estate.

Finally we will go into the automation of the system and the implementation at the organisation of housing associations.

1 INTRODUCTION

Housing managers face the continuous challenge to fit their housing stock to modern standards. The demand on housing services is continuously becoming more differentiated. In a general sense this not only refers to the product dwelling, but also to the dwelling environment. In comparison to the previous period matching of demand and supply has become more complicated and the need for information more differentiated.

Traditionally management organisations were structured along disciplinary lines, in
which the technical, the financial, administrative and the rental departments operated separately. Also the data input was developed along three separated routes. Within these disciplines exchange of data often took place, but hardly ever among them.

Under the present circumstances housing managers cannot do with such a disciplinary subdivision of tasks. Thus a 'technical' approach in which planned maintenance and renovation operations are implemented separately will not suffice. To cope with the challenge of the market also commercial approach has to be taken in consideration. Management should integrate technical and commercial deliberations in their decisions.

So, point of departure in developed approach is a decision making process in which the traditionally disciplinary vertical segregation among departments is overthrown and in which data are exchanged interdisciplinarily.

2 THE DECISION PROBLEM

During the adjustment of their housing stock managers will have to make decisions on the level of individual dwelling estates as well as on portfolio level. The decision making process on the estate level will continuously take place in relation with decision making on portfolio level. The strategic planning process on the level of dwelling estate (property-management-plan) as well on the level of the portfolio (policy-plan) has to be developed step by step.

Figure 1 shows the most important elements of this method: the formulation of objectives, the determination of the target groups, the SWOT-analysis, the identification of product/market combinations and strategic choices.

Specifically the objectives formulated in the policy-plan set the conditions to the steps, through which a property-management-plan will be formulated. These conditions are of many kinds: (Maussen and Smeets 1998)

- target groups
  The question concerning to what target groups should be housed depends a/o. on the mission of the housing landlord. For non-profit landlords this mission is also coloured by the regulations of the central government, where target groups of mass housing policy are mentioned. Commercial landlords will also have themselves guided by other considerations. It appears, however, that for them the market of lower income groups is also interesting.

- main stock
  Especially for non-profit housing managers the question concerning to which part of the portfolio has to be accessible for the target groups is of importance. What size should the 'main stock' have? This part of the portfolio has to be accessible for the target groups. In practice this often refers to dwellings with a certain amount of monthly rent, rendering into account the possibilities and limitations of the Individual Rent Subsidy.
- level of quality
In the process of defining the required level of quality a differentiated concept is indispensable: the present standards for new constructions are anyhow not
attainable in the existing stock. It can be desirable to develop a concept about a minimum standard quality, e.g. about energy efficiency. Moreover, the market demands a quality differentiation.

- **Investment opportunity**
  The opportunity for investment is among others determined by the current and intended position of the assets and the proposed rental policy. Often the adjustment of performances involve considerable investments, which only appear attainable if they in turn can be passed on to the tenants. On the reverse housing of certain target groups has only been viable within a certain bandwidth of rents and specifically additional investments cannot be passed on to the target group. The only possible solution thus is doing 'unprofitable' investments, by which the own funds will be influenced negatively.

- **Capacity**
  Suppose that adjustments are financially attainable, then still the time taken by which they are implemented is determined a/o. by the capacity of the organisation. From the point of view of the organisation setting up priority is often necessary; the task force can only cope with a limited number of projects, in the policy-making process as well as in the implementation phase.

In short, on the policy level the substantive, financial and organisational conditions for developing plan for property-management are determined. In the decision making process in order to arrive at management plans one should render these conditions into account. In the proposed decision making route these conditions are therefore integrated.

3 DECISION MAKING

To arrive at an approach the relevant policy data have to be systemized so as to make the choice of a strategy unambiguous. The relevant unit here is the 'dwelling estate'. This comprises several functions (see also Hortulanus 1995):

- The dwelling estate is an area that is inhabited, used and experienced;
- it is a planning- and administrative unit for the housing manager and a frame for representation of interest of the residents.
- it represents a certain economic value;

Specifically at the step of 'appropriate strategy per dwelling estate' the application of a decision table has appeared significant.

A decision table is 'a table that represents the exhaustive set of mutually exclusive conditional statements within a pre-specified problem area' (Verhelst 1980). It displays the possible actions that a decision maker can follow according to the outcome of a number of relevant conditions. Each condition has been exhaustively described and each condition status quo is exclusive. The condition set - the input - consists of all relevant conditions that have an influence on the decision making process. The action set - the output - contains all the possible action a housing manager is able to make (Witlox
This method of performance is perfectly suitable in a target oriented approach (Lucardie et al. 1995).

3.1 The condition set

The following unambiguously defined conditions set the 'input' of the decision tables (see also figure 2).

- the rentability index (RI) as a starting point for the decision making process. The higher the RI the worse the rentability. If the RI-index equals 100 then the situation is average. For an exhaustive explanation of this index we refer to a previously published DDSS-paper (Smeets 1992). A disadvantage of this index is that it can only give an indication of the rentability at a certain moment. Therefore it can only serve as a starting point in the decision making process.

- For that reason a trend of the RI ought to be added as a second condition. A complex with a poor rentability and a downward trend should be approached differently than one at which the trend is clearly upward. One can speak of a downward trend if this deviates 25% of the starting value.

- In the developed method of performance, the appreciation of the dwelling situation by the consumer is used as a third condition. Research on dwelling appreciation provides the required data hereto. For the appreciation during the decision making process the average appreciation of the relevant product group (e.g. small single family houses) is applied as standard (lower or higher than average).

- The decision whether the complex will be adapted to the current tenants or to new more intended target groups counts as a forth condition. The choice for the most suitable target group has already been made in a previous step (see also figure 1). The method of performing this exercise was described already earlier (Smeets 1997). By means of the so-called Product market combinations (PMC's) matching of product performances and client groups has been optimised.

- The fifth condition refers to the housing manager's policy of investment. For one reason or another managers can decide not to invest any longer in certain product groups or market estates. An imminent oversupply or simply the building's age might cause a decision. The general financial situation of the organisation can also be a reason not to invest (unprofitably). As soon as a decision not to invest has been made a number of strategies are disqualified (e.g. upgrading or optimising).

- Last but not least the decision whether or not to increase the rent plays an important role in the choice of a strategy. If a rent increase is not under consideration e.g. then the choice of profitability is not relevant.
### Figure 2: Decision table

<table>
<thead>
<tr>
<th>C1</th>
<th>rentability index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bad (RIo &lt; 100)</td>
</tr>
<tr>
<td></td>
<td>good (RIo &gt;= 100)</td>
</tr>
<tr>
<td>C2</td>
<td>tendency rentability index</td>
</tr>
<tr>
<td></td>
<td>downward (RIn &lt;= 0.75 * RIo)</td>
</tr>
<tr>
<td></td>
<td>stable (1.25 * RIo =&gt; RIn &gt;= 0.75 * RIo)</td>
</tr>
<tr>
<td></td>
<td>upward (RIn &gt;= 1.25 * RIo)</td>
</tr>
<tr>
<td>C3</td>
<td>appreciation</td>
</tr>
<tr>
<td></td>
<td>low (Ap &lt; average Ap)</td>
</tr>
<tr>
<td></td>
<td>high (Ap &gt; average Ap)</td>
</tr>
<tr>
<td>C4</td>
<td>changing target group</td>
</tr>
<tr>
<td>C5</td>
<td>possibility of investment</td>
</tr>
<tr>
<td>C6</td>
<td>changing rent</td>
</tr>
<tr>
<td>A1</td>
<td>priority</td>
</tr>
<tr>
<td>A2</td>
<td>consolidate</td>
</tr>
<tr>
<td>A3</td>
<td>increase revenues</td>
</tr>
<tr>
<td>A4</td>
<td>optimise</td>
</tr>
<tr>
<td>A5</td>
<td>specialise</td>
</tr>
<tr>
<td>A6</td>
<td>upgrade</td>
</tr>
<tr>
<td>A7</td>
<td>change rents</td>
</tr>
<tr>
<td>A8</td>
<td>dispose</td>
</tr>
</tbody>
</table>

For bad rentability index:

- **C1 rentability index**: bad (RIo < 100)
- **C2 tendency rentability index**: downward (RIn <= 0.75 * RIo), stable (1.25 * RIo => RIn >= 0.75 * RIo), upward (RIn >= 1.25 * RIo)
- **C4 changing target group**: yes, no
- **C5 possibility of investment**: yes, no
- **C6 changing rent**: yes, no
- **A1 priority**: 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 6, 6, 6, 6, 7, 7, 7, 7
- **A2 consolidate**: X, X, X, X
- **A3 increase revenues**:
- **A4 optimise**: X, X, X, X
- **A5 specialise**: X, X, X, X
- **A6 upgrade**: X, X, X, X
- **A7 change rents**: X, X, X
- **A8 dispose**: X, X, X, X

For good rentability index:

- **C1 rentability index**: good (RIo >= 100)
- **C2 tendency rentability index**: downward (RIn <= 0.75 * RIo), stable (1.25 * RIo => RIn >= 0.75 * RIo), upward (RIn >= 1.25 * RIo)
- **C4 changing target group**: yes, no
- **C5 possibility of investment**: yes, no
- **C6 changing rent**: yes, no
- **A1 priority**: 1, 1, 1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 6, 6, 6, 6, 7, 7, 7, 7
- **A2 consolidate**: X, X, X, X
- **A3 increase revenues**: X, X
- **A4 optimise**: X, X, X, X
- **A5 specialise**: X, X, X, X
- **A6 upgrade**: X, X, X, X
- **A7 change rents**: X
- **A8 dispose**: X, X, X, X
3.2 The actions

The output of the model has two sides. First of all, on the basis of the first three conditions a priority can be set.
A1. Priority
For example, is the rentability poor, the trend downwards and the appreciation low, the urgency is high. Is the rentability good, the trend upwards and the appreciation high, then extra attention has almost no priority.
Secondly the table selects the most appropriate strategy:
A2. Consolidate: maintain the actual management efforts;
A3. Increase revenues: increase the rent without additional investments;
A4. Optimise: additional investment for the target group that is accommodated in the complex;
A5. Specialise: allocation to some other than the current target groups with or without additional investments;
A6. Upgrade: additional investment for a new target group and including an increase of the rent;
A7. Change of rents: lower or temper the increase of the rent;
A8. Dispose: sell or demolish the estate.

Especially in the case of option 4, 5 and 6 the product-market combinations can play a role in the decision making process.
In the case of decreasing rentability and low appreciation by the target group that is accommodated in the estate another target group can be selected, if necessary in combination with additional investments.

4 AN EXAMPLE

As a case project we will describe a complex of 52 houses, built in 1968. It refers to a complex that is part of the product group 'small single family houses'. The average rent amounts to Dfl 606,- p.m.
The sitting target group specifically consists of large families and 1 and 2 persons households. The rentability index is positive (111) and the trend is stable (107). The appreciation of the dwelling situation is 'high'.
The manager involved is of the opinion that the present target groups can be maintained.
From the product-market combination it turns out that also for the current target groups an investment is necessary. It is here assumed that the current price level makes it possible to pass part of the costs on to the tenants.
In figure 3 is shown on the basis of our case complex what route has been taken in the decision table with the outcome: the strategy 'optimise', additional investment for the target group that is still accommodated in the estate.

The case refers to 2 target groups: singles/couples and families. Figure 4 shows an overview of the necessary investments in the context of this strategy.
Figure 3: Application of decision

<table>
<thead>
<tr>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
<th>A5</th>
<th>A6</th>
<th>A7</th>
<th>A8</th>
</tr>
</thead>
<tbody>
<tr>
<td>rentability index</td>
<td>tendency rentability index</td>
<td>appreciation</td>
<td>changing target group</td>
<td>possibility of investment</td>
<td>changing rent</td>
<td>priority</td>
<td>consolidate</td>
<td>increase revenues</td>
<td>optimise</td>
<td>specialise</td>
<td>upgrade</td>
<td>change rents</td>
<td>dispose</td>
</tr>
<tr>
<td>good (RIo &gt;= 100)</td>
<td>stable (1.25 * RIo =&gt; RIn &gt;= 0.75 * RIo)</td>
<td>low (Ap &lt; average Ap)</td>
<td>high (Ap &gt; average Ap)</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

In our case complex these investments are passed on to the tenants partially only, because the complex has to remain within the main stock. The new rent for the 1+2 persons households has been set on Dfl. 650,- and for the families on Dfl. 700,-.

Figure 4: Budget investments case project

<table>
<thead>
<tr>
<th>Quality to adjust</th>
<th>1+2 households</th>
<th>family improvement</th>
<th>Solution</th>
<th>1+2 households</th>
<th>family improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>green space</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>playing area</td>
<td>X</td>
<td>X</td>
<td>install furniture</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>sense of security</td>
<td>X</td>
<td>X</td>
<td>public lightning</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>size main bedroom</td>
<td>X</td>
<td></td>
<td>reduced size second bedroom</td>
<td>2500</td>
<td></td>
</tr>
<tr>
<td>size living room</td>
<td>X</td>
<td>X</td>
<td>open kitchen</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td>size kitchen</td>
<td>X</td>
<td></td>
<td>enlarge kitchen</td>
<td>21000</td>
<td></td>
</tr>
<tr>
<td>heating</td>
<td>X</td>
<td></td>
<td>HR + hotwater supply</td>
<td>8500</td>
<td></td>
</tr>
<tr>
<td>thermal insulation</td>
<td>X</td>
<td>X</td>
<td>double panes</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>sanitary installation</td>
<td>X</td>
<td>X</td>
<td>new shower</td>
<td>6200</td>
<td>6200</td>
</tr>
<tr>
<td>protection</td>
<td>X</td>
<td>X</td>
<td>improvement of fixtures</td>
<td>1200</td>
<td>1200</td>
</tr>
<tr>
<td>miscellaneous</td>
<td>X</td>
<td></td>
<td>costs of demolition/ removal</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>unforeseen</td>
<td>X</td>
<td>X</td>
<td>investment per dwelling</td>
<td>16350</td>
<td>50350</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>number of houses</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>sub total</td>
<td>425100</td>
<td></td>
</tr>
</tbody>
</table>

In our case complex these investments are passed on to the tenants partially only, because the complex has to remain within the main stock. The new rent for the 1+2 persons households has been set on Dfl. 650,- and for the families on Dfl. 700,-.
5 IMPLEMENTATION AND AUTOMATION

In the introduction we pointed out already the necessity of an exchange of information that surpasses departmental competitions. Implementing the complete method of performance as shown in figure 1, involves the intensive co-operation among the departments of ‘rental/commercial’, ‘financial’ and ‘technical’ affairs. The rental/commercial affairs department has a key role herein.

Figure 5 presents an overview of the origins of data, which have been used in the decision table. The data are processed by means of the Policy Analyses and Simulation System (PASS) developed elsewhere. The system refers to a relational database developed in PARADOX, a graphical oriented data system. PASS can be integrated with GIS systems too. In order to carry out analysis and to make simulations existing databases are related to each other. To make the linkage possible unambiguous pre-arrangements are made about selection and aggregation.

Three main sources are used for data processing in PASS:

1. Internal databases from which a/o data for the Rentability Index is drawn (condition C1 and C2). The appreciation data, collected by means of a survey among tenants are drawn from the data base too (condition C3).
2. As a second source serves an application (EXCEL) that has been designed by Interface at the Faculty of Architecture, Building and Planning, in which the so-called product/market combination are developed. The output of this data base presents an insight around the question which target groups are most suitable for the complex involved. This information is the input for the decision table (condition C4).
3. External databases of local governments’ (technical) departments, CBS-data, marketing agencies etc. These data, however, are not used in the decision table.

Already on the basis of C1 until C3 it is possible to determine the priority. This is already being done automatically. Temporarily, however, the last 2 conditions (C4 and C5) have not yet been implemented into an automatic system, in this way the final selection of a strategy based on the decision table still takes place manually.

Figure 5: Information provision related to departments

<table>
<thead>
<tr>
<th></th>
<th>rental/commercial</th>
<th>finance</th>
<th>technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>rentability</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>rentability trend</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>appreciation*</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>changing target group</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>changing target group</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>investment opportunity</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>changing rent</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* appreciation can be derived from the survey research
6 CONCLUSION

The proposed DSS system has realised an integration of technical, financial and commercial considerations in the decision making process for the management of housing estates. The presented decision table forms a significant component of an interrelated system of decisions. The requirements for the decision table (exclusive and exhaustive) cause the decision making process to be unambiguous and therefore more effective. In practice it also turns out that the development of this method of performance is a learning process, which contributes to creating a support group of people in all departments of the organisation, that benefits from the implementation. In figure 1 is shown that the complete set of decision steps is more complicated. Last but not least, the financial feasibility study is an essential part of the decision making process.

Additionally, however, considerations at portfolio level plays a important role. These decisions takes place in an even less structured environment. The need to have some play in the field of strategic decision making is created by the degree of priority (A1). Specifically at estates with low priority the actual implementation of an approach may still be postponed, which opens various options for the future.

In times of increasing uncertainty the proposed method will anyhow lead to a faster and more effective decision making process, with which the decisiveness of the real estate organisation is significantly enhanced. Possibly this explains the wide acceptance by the users of this presented method.
Acknowledgement:
The authors would like to thank Theo Arentze (Urban Planning Group, Departement of Town Planning, Eindhoven University of technology) for his useful comments on an earlier draft of this paper.

References