Received 2 December 2014
Revised 9 March 2015
Accepted 10 March 2015

Designing a preference-based accommodation strategy

A pilot study at Delft University of Technology

Monique Arkesteijn
Real Estate & Housing/Faculty of Architecture and The Built Environment, Delft University of Technology, Delft, The Netherlands, and
Bart Valks, Ruud Binnekamp, Peter Barendse and Hans De Jonge
Delft University of Technology, Delft, The Netherlands

Abstract

Purpose – This paper aims to describe the development and test of such a design method to achieve alignment, which utilises the preference-based accommodation strategy (PAS) design procedure. One of the long-standing issues in the field of corporate real estate management is the alignment of an organisation's real estate to its corporate strategy. A classification of alignment models shows that no model yet exists that is able to design a real estate portfolio and makes use of scales for direct measurement of added value/preference, and allows the aggregation of individual ratings into an overall performance rating.

Design/methodology/approach – To perform the steps in the PAS design procedure, a mathematical model is designed and tested according to formal design principles. The PAS design procedure is iteratively repeated with the participants in a series of interviews and workshops. In the interviews, the participants determine their preferences and constraints as prescribed in the procedure; in the workshops, they design alternative portfolios using the mathematical model. The objective of the research is to formulate, test and evaluate if participants are able to perform the PAS design procedure.

Findings – A methodology is developed for designing a real estate strategy that uses explicit scales for measuring value/preference and enables aggregating individual preference ratings into an overall rating taking into account both quantitative and qualitative portfolio properties. The tests of this design method with the participants reveal that by completing the steps in the PAS design procedure, users are able to determine their preferences accordingly. They were also able to design an alternative portfolio with a higher overall preference score than the current real estate portfolio. In addition, the design method is evaluated positively by the participants based on their experiences, the attractiveness of the method and perception of effectiveness of the method.

Research limitations/implications – The positive results suggest that designing a strategy by using the PAS design procedure is a suitable approach to alignment.

Practical implications – The PAS design procedure enables corporate real estate (CRE) managers to determine the added value of a real estate strategy. Because the PAS design method is generic, it can be used for a wide range of real estate portfolios.

Journal of Corporate Real Estate
Vol. 17 No. 2, 2015
pp. 98-121

1463-001X
DOI 10.1108/JCRE-12-2014-0031

The authors thank the department of Facilities Management and Real Estate of the DUT and especially their director Anja Stokkers for her desire to innovate and the ability to perform the pilot study. We also thank all persons who have participated the pilot study. Finally, we would like to thank Theo van der Voordt and Chris Heywood for their contribution to the improvement of this paper.

Originality/value – The first CRE alignment model uses stakeholders preferences to design a more optimal real estate strategy.

Keywords Decision-making, Decision support system, Corporate real estate management, CRE alignment, CRE strategy, Preference measurement

Paper type Research paper

1. Introduction

Organisations use a substantial number of buildings which have been acquired or leased to accommodate their organisation. The management of this portfolio is often referred to as corporate real estate management (CREM) (De Jonge *et al.*, 2009; Appel-Meulenbroek, 2014). Other terms are also used, like corporate real estate asset management (CREAM) by Nunnington and Haynes (2011) and real estate asset management by Then (2005). De Jonge *et al.* (2009) and Van der Schaaf (2002) also refer to a more specific CREM called public real estate management (PREM) which is REM by public parties. In this paper, the term CREM will be used.

Krumm *et al.* (2000, p. 32) define CREM as:

> […] the management of a corporation's real estate portfolio by aligning the portfolio and services to the needs of the core business (processes), to obtain maximum added value for the business and to contribute optimally to the overall performance of the corporation.

Two years later, Van der Schaaf (2002, p. 6) defined PREM within governments as:

> […] the management of a government's real estate portfolio by aligning the portfolio and services to the needs of the users, (the financial policy set by the treasury and the political goals that governments want to achieve.

Although these definitions are not universally acknowledged, Heywood (2011) shows that the process of alignment and attuning real estate is an issue: "A long-standing issue for CREM is the relationship between corporate real estate (CRE) and organisational strategies to deliver value to the organisation". This is in line with Kaplan and Norton's (2006) position that "Alignment of all an organisation's cost and value-creation activities is important in achieving enterprise-wide value".

As stated by Then and Tan (2010, p. 33) who use Kaplan and Norton as their reference:

> Alignment in an active sense implies moving in the same direction, supporting a common purpose, being synchronised in timing and direction, being appropriate for the purpose and in a passive sense the absence of conflict.

Heywood (2011) bases his definition of alignment on the Shorter Oxford Dictionary definitions as the bringing into harmony things that differ or could differ (for instance, corporate strategy and real estate strategy) by making them consistent or in agreement with each other (based on).

In the CREM literature, there are several models for the alignment of CRE and organisational strategies.

Alignment in these models is often not defined explicitly. Heywood (2011, p. 8) therefore identified four main forms of alignment in the alignment models; alignment is seen as an artefact (plan), a process, a behaviour or a state. His research shows that alignment as a process predominates while the models imply that alignment is a state.

To optimally attune CRE to the corporate performance, the authors want to be able to determine whether a CRE alignment process delivers a more optimal alignment and, therefore, focus on alignment as a state as their starting point.

According to Heywood (2011, p. 2), evidence from practice indicates that these [alignment models] are not being used, although CRE practitioners are consistently able to answer surveys on the positive state of their CRE alignment. Heywood (2011, p. 5) finds that the models together consist of 15 alignment components but also finds:

> […] a degree of variability and completeness in the existing approaches [which] makes it hard to see how these approaches can act as an effective standard or prescription for the practitioner employing them (Heywood, 2011, p. 10).

Arkesteijn and Heywood (2013) group these components into four building blocks:

(1) understanding corporate strategy;

(2) understanding real estate performance;

(3) making a real estate strategy; and

(4) implementing a real estate strategy.

Alignment as a state becomes most evident in the building block understanding real estate performance. Arkesteijn and Heywood (2013) position three components in this block:

(1) audit of existing real estate;

(2) real estate data/information; and

(3) assess the effect of CREM actions.

In an audit of existing real estate, one can determine the current state of alignment of the CRE portfolio. However, only after "making and implementing a real estate strategy", one is able to determine whether the CRE strategy has been optimally attuned. This is done in the component assess the effect of CREM actions. Therefore, the authors argue that a CRE alignment model cannot only be an evaluation method but also that it needs to be a design method.

In a design method, one or more alternative real estate strategies are made. Examples found in literature are Nourse and Roulac (1993) and Roulac (2001), who identify eight real estate strategies resulting in specific operating decisions. The accommodation strategy[1] is a combination of one (or more) of these strategies (together). In a design method, the objective is to design the best possible alternative. In an evaluation method, the current real estate strategy and with it current real estate portfolio is evaluated. The objective of an evaluation method is to assess the current situation. The combination of making and implementing a real estate strategy consists of multiple CREM actions resulting in alternative real estate portfolios. The word strategy is used both as process and content: as Chaffee (1985, p. 89) states, "the study of strategy includes both the actions taken, or the content of strategy, and the processes by which actions are decided and implemented". Identifying and analysing alternatives, selecting the best alternative with a view to future developments and executing the strategy are considered an integral part of strategic management, according to Snyder and Glueck (1980, p. 73) and Mintzberg (1994a, p. 9). When addressing "making a real estate strategy", the alignment models refer both to strategy as a content and strategy as a process. When studying the alignment state, the authors will refer to the alignment reached by the strategy content.

In CREM, research into alignment is focused more on strategy as a process than strategy as a content. De Jonge *et al.* (2009) studied the selection process in six models and concluded that most models briefly touch upon the selection process and only indicate the type of selection. Osgood (2004, p. 75) for instance uses cause and effect relationships and states that "the author interprets the concepts and develops ideas that describe ways that real estate can align with and reinforce the strategy". O'Mara (1999) follows Porter (1980, 1985, 1996) and positions three generic strategies between the dimensions "strategic uncertainty" and "view on action". She also states that:

> Although learning about the struggles other companies have gone through can help you see patterns in your company's behaviour, there is not one set of rules to follow in developing a strategy that will work best for your company (O'Mara, 1999, p. 189).

Roulac (2001) uses conceptual linear programming: he gives tables in which he addresses eight alternative accommodation strategies in terms of alternative choices that enterprises are confronted with concerning the places in which they operate. The eight alternative real estate strategies can be related to the seven contributions of the superior corporate strategy for competitive advantages.

The result is that alignment models can be difficult to use when looking at the selection of an accommodation strategy, as is concluded by Arkesteijn and Binnekamp (2013). They find that the models suggest selecting the best alternative but did not have a well-defined procedure for doing so. In their view, a well-defined procedure would allow a real estate manager to use the model himself without needing extra information or help from the author(s). This procedure needs to be operational, and their view is that if alignment is perceived as a state, it should be measured.

Measuring the alignment state often includes qualitative (subjective) and quantitative (objective) data. According to Gerritse (1999, p. 9), the meaning that people assign to the term quality often leads to confusion. ISO (2005, Chapter 3.1.1) has defined quality as "Degree to which a set of inherent characteristics fulfils requirements". In this definition, quality reflects the judgment of one or more persons with regards to a characteristic or set of characteristics. This judgment is bounded by time, place and culture. Furthermore, in the summation of characteristics relating to quality, another problem is found: how to measure the quality of these characteristics. In CREM, the same issues are relevant; the CRE alignment models also indicate the importance of both quantitative and qualitative criteria and indicators or variables. However, in CREM, instead of referring to quality, mostly the term value or adding value is used. The authors' position of alignment as a state requires a value measurement which should be able to include both quantitative (e.g. carbon emissions) and qualitative (e.g. architectural value) characteristics.

On measuring the quality of an object or characteristics of an object, Barzilai (2010, p. 71) states the following:

> […] value (or utility, or preference) is not a physical property of the objects being valued, that is value is a subjective (or psychological, or personal) property. Therefore, the definition of value requires specifying both what is being valued and whose values are being measured.

Put in the terms used in the definition given by International Organisation for Standardization (ISO): although most characteristic of an object can be objectively measured, the degree to which it fulfils the requirements remains subjective. The requirement needs to be set by someone. Value, utility or preference can therefore not be defined objectively.

When selecting an intervention or a series of interventions in CREM, there often is an existent real estate portfolio with an existent value: in other words, the portfolio is already aligned to a certain degree. In the process of selection, the question is: which interventions result in the most *added value* to the real estate portfolio? In CREM, strategies are usually made to provide the answer to this question. When selecting a strategy to achieve the state of alignment, one needs to determine the value of the current real estate portfolio and the value added by the different strategies. The strategy that maximises the added value is selected.

In summary, the authors argue that the following aspects can be used to determine whether alignment as a certain state is reached:

- Is the method an evaluation or a design method?
- Are scales used to determine whether quantitative and qualitative requirements are met and are they established directly by decision-makers?
- Is the performance on criteria aggregated into an overall performance rating?

In Table I, the existing CRE alignment models are reviewed based on these three aspects. This is done to determine if an existing method is able to determine alignment as a state as defined by the authors.

The evaluation methods assess the current alignment between the organisation and CRE (strategy). Scheffer *et al.* (2006), on the other hand, predefine added values based on which they assess the current CRE strategy. In the model, scales are used to measure the alignment and the state of alignment is calculated in an overall measure, defined as "the percentage use of the added value contributing to the specific driving forces" while they also indicate "the percentage use of other added values". The other two evaluation models do not use an overall measure of alignment. Appel-Meulenbroek *et al.* (2010) use

Authors	Design or evaluation method	Scales used by decision-makers	Aggregation of overall performance
Nourse and Roulac (1993)	Design	Implied	No
Weatherhead (1997)	Design	No	Financial
White (1998)	Design	Implied	Nno
O'Mara (1999)	Design	No	No
Englert (2001)	Design	Implied	Financial
Edwards and Ellison (2003)	Design	Implied	No
Osgood (2004)	Design	Implied	Financial
Wills (2005)	Design	No	No
Haynes (2008)	Design	No	No
De Jonge *et al.* (2009)	Design	No	No
Then and Tan (2010)	Design	Implied	No
Den Heijer (2011)	Design	Yes	No
Scheffer *et al.* (2006)	Evaluation	Yes	Yes
Appel-Meulenbroek *et al.* (2010)	Evaluation	n.a.	n.a.

Table I.
Classification of alignment models

scales to validate the alignment table of Nourse and Roulac (1993) but do not measure the state of the CRE portfolio and is therefore not applicable in the comparison. The evaluation models use experts in real estate (RE)/facility management (FM) as decision-makers; however, none of the models involve other decision-makers to measure whether the CRE strategy content fulfils their specific requirements.

Of the CRE alignment models that are a design method, five do not use scales to measure value while six imply to use scales. However, they do not show how and by whom this is done. Only the model of Den Heijer (2011), which follows De Jonge *et al.* (2009), uses scales to measure value. O'Mara (1999) also uses scales but to measure the context of the organisation (e.g. strategic environment uncertainty) and not the values that the decision-makers want to achieve with their CRE strategy. Then and Tan (2010), for instance, indicate how the alignment can be assessed with their model and indicate which alignment criteria should be taken into account. These criteria are quantitative and qualitative and therefore imply that scales will be used. In the conceptual model, it is not clear if or which scales are used to measure the criteria. In their model, they indicate that existing and new facilities can be assessed; however, the design of the new real estate portfolio is not discussed.

Only three models have an overall performance measure. Englert (2001) uses economic value added (EVA) and return on net assets (RONA) as overall financial performance measure while Osgood (2004) also mentions EVA and shareholder value. Weatherhead (1997) uses the highest net present value. But by doing so, they do not take into account other attributes than financials in their CRE strategy design, at least not in their overall measure. None of the models have a measurement made by the decision-makers to establish their own criteria and their desired performance.

From Table I, we conclude that currently no method exists that allows designing a portfolio, makes use of scales for direct measurement of added value/preference and allows the aggregation of individual ratings into an overall performance rating. In this paper, we propose and test a methodology for designing a real estate strategy that uses explicit scales for measuring value/preference and enables aggregating individual preference ratings into an overall rating. In the proposed methodology, both quantitative and qualitative portfolio properties are taken into account.

2. Preference-based accommodation strategy design

Arkesteijn and Binnekamp (2013) propose the preference-based accommodation strategy (PAS) design procedure (previously referred to as preference-based portfolio design). The PAS design procedure is based on preference function modelling (PFM) (Barzilai, 1997). This procedure consists of the following six steps:

(1) *Step 1*: Specify the decision variable(s) the decision-maker is interested in.

(2) *Step 2*: Rate the decision-maker's preferences for each decision variable by fitting a curve through three decision variable value/preference rating coordinates as follows:
   - Establish (synthetic) reference alternatives which define two points of the curve.
   - Define a "bottom" reference alternative, the alternative associated with the value for the decision variable that is least preferred, rated at 0. This defines the first point of the curve (x0, y0).

- Define a "top" reference alternative, the alternative associated with the value for the decision variable that is most preferred, rated at 100. This defines the second point of the curve (x1, y1).
- Rate the preference for an alternative associated with an intermediate decision variable value relative to the reference alternatives. This defines the third point of the curve (x2, y2).

(3) *Step 3*: To each decision variable, assign decision-maker's weight.

(4) *Step 4*: Determine the design constraints.

(5) *Step 5*: Generate all design alternatives (using the number of buildings and allowed interventions). Then use the design constraints to test their feasibility.

(6) *Step 6*: Use the PFM algorithm to yield an overall preference scale of all feasible alternatives.

Curves commonly used in operations research (OR) for curve fitting are Lagrange polynomials (Binnekamp, 2010, p. 101). The Lagrange interpolating polynomial is a polynomial P(x) of degree ≤ (n − 1) that passes through n points [x1, y1 = f(x1)], [x2, y2 = f(x2)], [xn, yn = f(xn)]. The formula was first published by Waring (1779), rediscovered by Euler in 1783 and published by Lagrange in 1795.

In the procedure described above, a Lagrange polynomial is used to fit a curve through three points as defined by the decision-maker. For each value of x, the corresponding value of y can be found by the following formula:

$$
\begin{aligned}
P(x) = {} & ((x - x1)(x - x2)/(x0 - x1)(x0 - x2)) * y0 \\
& + ((x - x0)(x - x2)/(x1 - x0)(x1 - x2)) * y1 \\
& + ((x - x0)(x - x1)/(x2 - x0)(x2 - x1)) * y2+
\end{aligned}
$$

Figure 1 displays an example of a criterion determined by a decision-maker. If a student has to attend on average 1.5 lectures per week after 5:00 pm, the formula above can be used to calculate that the corresponding preference rating of the student is 32.5.

In Step 6, the alternative with the highest overall preference score is the alternative that will be selected. Note that in this method, each stakeholder that establishes his or her preferences becomes a "decision-maker": the design alternative is chosen based on their preferences. When testing this procedure in the pilot study, most of the steps were slightly adjusted to explicitly state that either one or multiple decision-makers can

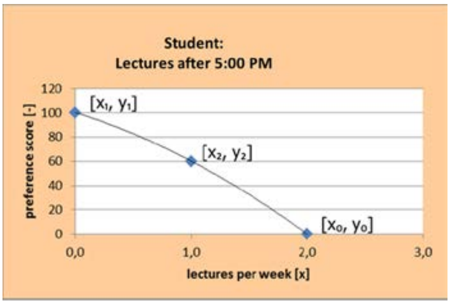


Figure 1.
Example of a Lagrange curve (Table II, criterion 14)

use the procedure. The PAS design procedure was formulated for one decision-maker while more decision-makers were implicitly foreseen. Although not formulated in the procedure, multiple stakeholders were part of the proof of concept (Arkesteijn and Binnekamp, 2013, p. 98). This has two implications for the procedure as well. The first implication is to add the selection of decision-makers is before starting the procedure:

> […] the real estate manager, who often initiates a strategy design procedure, states the subject (or problem) of the strategy design and selects the subject (or problem) owner. The manager and subject owner select the relevant stakeholders.

The weights between the decision variables of a certain decision-makers are determined in Step 3. However, the weights between decision-makers were only implicitly part of the procedure (Arkesteijn and Binnekamp, 2013, p. 96). The second implication therefore is to add to Step 3 that the subject owner assigns the weights between the decision-makers.

In this pilot study, it was not possible to perform Step 5 and consequently Step 6 of the procedure. This was not possible because the number of design alternatives to be generated in Step 5 became too large. Therefore, a search algorithm was needed instead of Steps 5 and 6. This search algorithm, however, was not available at the time of this pilot. As solution, Steps 5 and 6 were altered. The decision-makers in the pilot designed the alternatives themselves. Each design alternative has an overall preference score. In the model, the overall preference score is calculated as the weighted sum of all the separate preferences to be able to give immediate feedback to the decision-makers. The current situation is defined as design alternative d_0. The decision-makers try to maximise the overall preference score by finding a design alternative with a higher overall preference score than in design alternative d_0. For each of these design alternatives, the feasibility is tested using the design constraints. The interventions are designed by the systems engineer based on the decision variables from Step 1 and the user's preferences given in Step 2.

The above changes mean that the original PAS design procedure needs to be changed as follows:

(1) Each decision-maker specifies the decision variable(s) they he/she is interested in.

(2) Each decision-maker rates his/her preferences for each decision variable as follows:
- The decision-maker establishes (synthetic) reference alternatives which define two points of a Lagrange curve.
  - A "bottom" reference alternative is defined, which is the alternative associated with the value for the decision variable that is least preferred, rated at 0. This defines the first point of the curve (x0, y0).
  - A "top" reference alternative is defined, which is the alternative associated with the value for the decision variable that is most preferred, rated at 100. This defines the second point of the curve (x1, y1).
- The preference for an alternative associated with an intermediate decision variable value relative to the reference alternatives is rated. This defines the third point of the curve (x2, y2).

(3) Each decision-makers assigns weights to his/her decision variable. The subject owner assigns weights to each decision-maker.

(4) Each decision-maker determines the design constraints he/she is interested in.

(5) The decision-makers generate design alternatives group wise and use the design constraints to test the feasibility of the design alternatives. The objective is to try to maximise the overall preference score by finding a design alternative with a higher overall preference score than in the current situation.
(6) The decision-makers select the design alternative with the highest overall preference score from the set of generated design alternatives.

3. Research method

The PAS design procedure was tested by constructing a mathematical model in accordance with the five stages of an operation research project (Ackoff and Sasieni, 1968, p. 11):

(1) formulating the problem;
(2) constructing the model;
(3) deriving a solution;
(4) testing the model and evaluating the solution; and
(5) implementing and maintaining the solution.

The PAS design procedure is embedded in these five stages. Stage 1 incorporates Step 1 to 4 of the PAS design procedure (via interviews). Stage 3 and 4 were combined to incorporate Step 5 and 6 of the PAS design procedure (via workshops). There was a feedback loop present from Stage 4 to Stage 1, i.e. the stages were used in an iterative way, so that the model could be adjusted in accordance with the results of the evaluation of the solution.

In the PAS design procedure, the decision-maker specifies criteria (Step 1) and establishes a preference scale for each criterion (Step 2). The purpose of measurement, i.e. representing variables by devising scales, is to enable the application of mathematical operations to these scale values. This is necessary in Steps 5 and 6 of the procedure in order to determine the performance of the portfolio design alternatives.

In the pilot study, we establish a mathematical (formal) model representing the university's lecture halls and the preferences pertaining to them. The construction of this model is done to solve two problems. Primarily, it is done to demonstrate if and how in a generic sense the alignment problem can be solved by using the PAS design procedure. Secondarily, it is done to generate and select solutions to solve the specific problem of the Delft University of Technology's (DUT) lecture halls.

In this pilot study, a linear programming (LP) model was constructed to determine and optimise the performance of the university's timetable. This is because in educational space, the feasibility of a solution is not only determined by what the decision-makers want but also by the amount of required activities to be hosted. Other types of real estate where this could be used include meeting rooms, conference centres and sports facilities, i.e. other types of real estate where the availability in both time and space determine the feasibility. By means of LP, a timetable is modelled that can be used to assess if a solution (i.e. the future set of lecture halls) is able to host the university's activities.

Furthermore, after each workshop, the PAS design procedure is evaluated with the participants. We used three aspects as indicated by Joldersma and Roelofs (2004, pp. 697-698) to assess the impact of methods such as the PAS design procedure on problem structuring:

(1) experiences with the method;

(2) attractiveness of the method; and

(3) perception of effectiveness of the method.

The interviews (I) and workshops (W) are completed a number of times in a sequence: I-W-I-W-I. In the remainder of this paper, the results of the second workshop and third series interviews will be discussed. If the participants are able to complete the procedure, i.e. to determine their preferences and constraints and make portfolio designs with a higher overall preference score, it is possible to use the PAS design procedure in practice. The results of the evaluation will show the impact of the procedure.

4. Testing the PAS design procedure in a pilot study

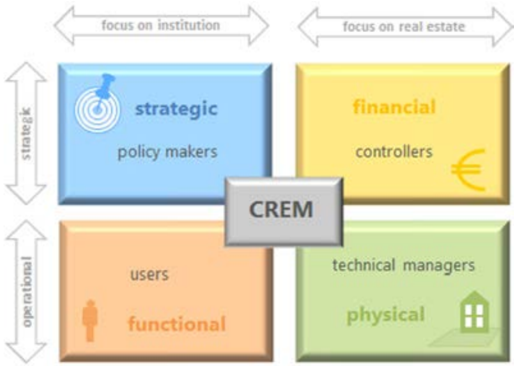
The PAS design procedure is tested at the DUT. DUT is located in the city of Delft, a small city between the large cities of Rotterdam and The Hague in the Western part of The Netherlands. The university currently accommodates 18,800 students and 7,600 employees (including 1,600 guests). In terms of land and buildings, DUT is the second largest university in The Netherlands: its building portfolio consists of 570,000 m^2 gross floor area. In addition, the university owns approximately 170 hectares of land.

The pilot study reported in this paper specifically concentrates on the university's large lecture halls: lecture halls exceeding a capacity of 160 seats (Figure 2). At the outset of the project, a Board of Directors member was appointed as subject owner. Together with the real estate manager, they find the university's lecture halls to be subject to the following problems:

- The current supply of lecture halls does not meet present-day requirements with regards to facilities and capacity.
- The university is starting a new undergraduate curriculum in 2013, which will lead to a changing demand for lecture halls.
- There are too little types of educational facilities to accommodate this changing demand.
- The current supply is being used ineffectively: occupancy and utilisation rates of lecture halls suggest that an increase in efficiency is possible.

The real estate manager and the Board of Directors determined which users were to participate in the pilot, using the CREM model by Den Heijer (2011) (Figure 3). According to Den Heijer, it is important to involve each of these four stakeholder perspectives in the decision-making process so as to incorporate all relevant information and add value in the broadest sense (Den Heijer, 2011, p. 108). Figure 5 displays the stakeholders that participated in the pilot. Some stakeholders consisted of multiple participants (e.g. Education and Student Affairs) whilst others consisted of only one participant (e.g. Board of Directors) (Figures 3 and 4).

Figure 2.
DUT's large lecture halls (160+ seats)



Source: 10 > Den Heijer (2011)

Figure 3. Stakeholder perspectives

	Stakeholder	Examples of Criteria
	Board of Directors	Student satisfaction, teacher satisfaction
	Directors of Education	Students in own faculty, availability SMARTboard
	Facility Management and Real Estate	Running costs, occupancy rate
	Student Council	Evening lectures, lectures in own faculty
	Teacher Board	Student walking distance, availability SMARTboard
	Education and Student Affairs	Occupancy rate, Match students/capacity lecture hall

Figure 4. Participating stakeholders in the pilot study

5. Results: strategy content

5.1 Step 1: specify the criteria the user is interested in

The criteria defined by each stakeholder (Table II) reveal that the performance of the university's lecture halls depends only partly on the amenities available in the lecture hall. A large part of the performance also depends on the way the lecture halls are used by the university. The users of the lecture halls are generally concerned about the amenities in the lecture halls and the vicinity of the lecture hall to their workplace. The technical managers focus on the efficiency of the portfolio (occupancy rate and costs) while the Board of Directors is interested in both efficiency and satisfied users.

With regards to the amenities in lecture halls, the criteria reveal that some amenities are found to be important or even necessary by multiple users: examples include modern teaching amenities such as Collegerama and four-quadrant beamers. Collegerama is an apparatus for recording lectures, whilst a four-quadrant beamer allows the teacher to work with four separate projections. Other amenities, such as power outlets for laptop use or comfortable chairs are not mentioned at all.

5.2 Step 2: determining preferences

For each criterion, the stakeholders determined a bottom reference alternative (x_0, y_0), a top reference alternative (x_1, y_1) and an intermediate reference alternative (x_2, y_2). The preference ratings displayed in the table correspond with the preference ratings at the end of the second workshop.

As an example, Figure 5 displays preference ratings of the participant 'Education and Student Affairs to the criteria "occupancy rate." In Figure 5, the bottom reference

Decision maker	Criterion	$[x_0, y_0]$	$[x_1, y_1]$	$[x_2, y_2]$
Board of Directors	Education in small groups (% of total hours scheduled)	[0, 0]	[50, 100]	[40, 80]
	Student satisfaction (% of preference score on criteria 13-21)	[45, 0]	[85, 100]	[75, 80]
	Teacher satisfaction (% of preference score on criteria 22-29)	[45, 0]	[85, 100]	[75, 80]
	Occupancy rate (hours scheduled/capacity in hours)	[30, 0]	[70, 100]	[55, 80]
Directors of Education	First year students: lectures in own faculty (% of total hours scheduled)	[25, 0]	[90, 100]	[70, 75]
	Second year students: lectures in own faculty (% of total hours scheduled)	[20, 0]	[60, 100]	[40, 70]
	Third year students: lectures in own faculty (% of total hours scheduled)	[0, 0]	[20, 100]	[10, 4]
	Appropriate classroom size (ratio between students and lecture hall capacity)	[150, 0]	[100, 100]	[120, 60]
	Availability of four-quadrant beamer (% of lecture halls)	[30, 0]	[100, 100]	[60, 80]
	Availability of blackboard and beamer (% of lecture halls)	[80, 0]	[100, 100]	[90, 60]
	Availability of flexible chairs (% of lecture halls)	[0, 0]	[30, 100]	[15, 60]
	Education in small classrooms (% of lecture halls)	[2, 0]	[12, 100]	[8, 70]
Student Council	Amount of lectures recorded (Collegerama) (% of lectures in lecture halls with Collegerama)	[75, 0]	[100, 100]	[80, 30]
	Amount of lectures in the evening (% of lectures scheduled after 5:00 PM)	[2, 0]	[0, 100]	[1, 40]
	Amount of movements between buildings (% of total lectures in another building than the previous)	[3, 0]	[0, 100]	[2, 20]
	Lectures in own faculty (% of total hours scheduled)	[50, 0]	[100, 100]	[75, 60]
	First year students: lectures in own faculty (% of total hours scheduled)	[25, 0]	[90, 100]	[75, 70]
	Second year students: lectures in own faculty (% of total hours scheduled)	[20, 0]	[80, 100]	[50, 70]
	Third year students: lectures in own faculty (% of total hours scheduled)	[0, 0]	[50, 100]	[25, 20]
	Availability smartboard or four-quadrant beamer (% of lecture halls)	[20, 0]	[100, 100]	[50, 30]
	Flexible lecture halls (% of lecture halls)	[0, 0]	[30, 100]	[15, 60]
Teacher	Standard equipment (% of lecture halls)	[0, 0]	[100, 100]	[50, 40]
	Blackboards/whiteboards (% of lecture halls)	[50, 0]	[100, 100]	[80, 60]
	Flexible chairs (% of lecture halls)	[30, 0]	[80, 100]	[60, 60]
	Walking distance for students (minutes)	[15, 0]	[5, 100]	[10, 25]
	Amount of lectures recorded (Collegerama) (% of lectures in lecture halls with Collegerama)	[0, 0]	[100, 100]	[80, 90]
	On-site assistance (minutes)	[10, 0]	[2, 100]	[5, 20]

(*continued*)

Table II. Criteria and their respective preferences

Decision maker	Criterion	$[x_0, y_0]$	$[x_1, y_1]$	$[x_2, y_2]$
	Assistance in transport of teaching materials (hours)	–	–	–
	Reservation of parking spots (% of parking spots available on-demand for teachers)	[0, 0]	[100, 100]	[20, 20]
Education and Student Affairs	Walking distance for students (minutes)	[15, 0]	[5, 100]	[10, 50]
	Appropriate classroom size (ratio between students and lecture hall capacity)	[150, 0]	[100, 100]	[125, 80]
	Occupancy rate (hours scheduled/capacity in hours)	[100, 0]	[70, 100]	[80, 90]
	Functionality of lecture hall equipment (% of total hours in which there are no defects)	[95, 0]	[99, 90]	[100, 100]
FMRE	Occupancy rate (hours scheduled/capacity in hours)	[0, 0]	[70, 100]	[40, 50]
	Appropriate classroom size (ratio between students and lecture hall capacity)	[50, 0]	[90, 100]	[75, 80]
	Running costs (€)	[130, 0]	[100, 100]	[110, 80]

Table II.

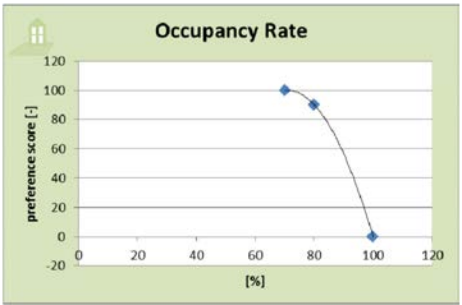


Figure 5. Lagrange curve relating preference rating to the occupancy rate (criterion 32) of the university's portfolio of lecture halls

alternative (x_0, y_0) is set at 100 per cent, because the participant has no flexibility left in the timetable if the occupancy rate of the lecture halls is 100 per cent. The top reference alternative (x_1, y_1) is set at 70 per cent, because the department's experience is that this leaves enough room in the timetable for extracurricular and/or unforeseen events (Table III).

5.3 Step 3: assigning weights

The weights assigned to each criterion are displayed in the Figure 6 below. The weights between each stakeholder were determined by the Board of Directors to be split equally; therefore, each stakeholder has a weight of 16.67 per cent.

5.4 Step 4: determining design constraints

A total of five design constraints were determined by the stakeholders, mostly related to scheduling issues rather than real estate issues. What the design constraints also reveal is that for Education and Student Affairs, the priority is to timetable all the university's activities within the specified constraints. Once this is achieved, certain efficiency is desirable (see criteria), i.e. finding a good student/capacity ratio only becomes important after a solution is found that incorporates all design constraints.

5.5 Step 5: generating alternatives

The main objective of designing alternatives is to maximise the overall preference rating. In this particular case, two types of interventions are possible: organisational and real estate interventions. With regards to the timetable, the following organisational interventions are possible:

- set boundary conditions on the percentage of lectures in the own faculty;
- enable/disable scheduling in the evening hours;
- enable/disable scheduling in the lunch hours;

Table III.
Design constraints incorporated into the scheduling model.

Decision-maker	Design constraint
Student Council	Two-way interaction with the teacher at all times
	The amount of students present cannot exceed the lecture hall capacity
Education and Student Affairs	The DUT must have enough capacity to accommodate all mandatory activities
	The maximum amount of scheduled hours per student per day is eight hours
	Mandatory courses cannot be scheduled at the same time

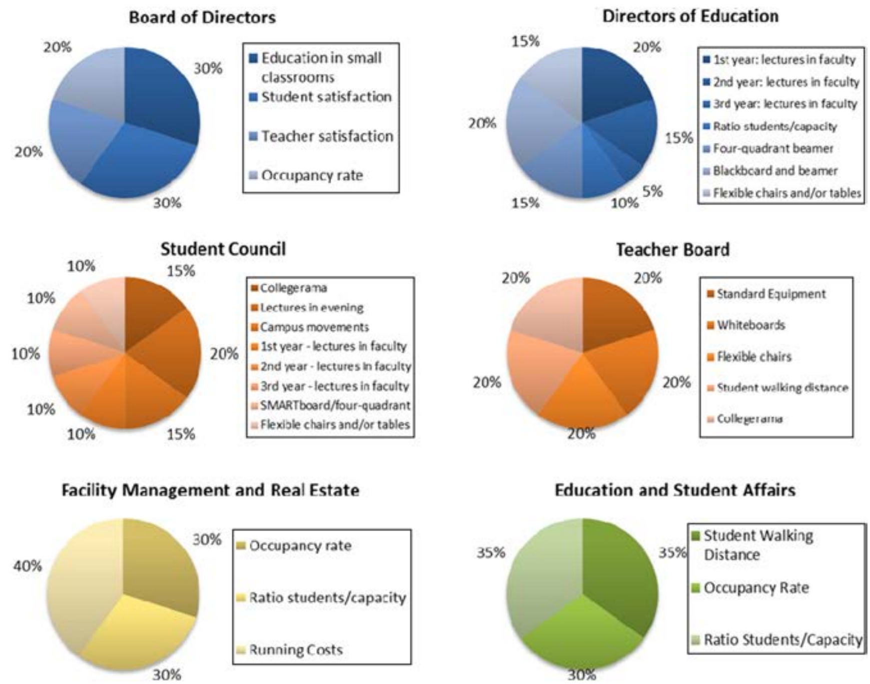


Figure 6.
The division of weights per criterion, as determined by each decision-maker

- set the allowed walking distance between lectures to 5, 10 or 15 minutes;
- enable/disable the new education programs in the bachelor phase; enabling will lead to less lectures;
- set the amount of options given by the teacher for a suitable moment to high, medium or low; and
- vary the amount of total students on the campus.

Table IV shows the values of these interventions in the current situation (design alternative d_0) and in the resulting design alternative of the second workshop.

In the workshops, the first objective for the participants was to maximise the amount of lectures in the own faculty. Because fixing these values leads to the reduction of the feasible set[2], other variables were set to increase flexibility: adding new bachelor programs, increasing walking distance and the amount of options (in time) given by the teachers. With regards to real estate, a range of interventions could be applied to each lecture hall:

(1) remove lecture hall;

(2) do nothing;

(3) renovate lecture hall (by doing one or more of the following):
   - add power sockets;
   - add Internet;
   - add four-quadrant beamer;
   - add blackboard;
   - add whiteboard;
   - add smartboard;
   - add Collegerama (recording device); and
   - add swiveling chairs or flexible chairs and tables.

(4) add new lecture hall.

Figure 7 displays the portfolio of lecture halls in the current and future design alternatives. With the exception of lecture Hall 1, all the existing lecture halls have been renovated. Lecture Hall 19 could have been added to the portfolio if necessary, but in the design alternative, this option was not used. The combination of design interventions in the timetable and the lecture halls yielded the following design result per criterion (Table V).

6. Results: strategy process

6.1 Evaluating the design process

During the test of the model, the design process was evaluated with the participants. To determine the impact of PAS, the participants were asked to react on their experiences with the method, the attractiveness of the method and their perception of effectiveness of the method.

The interviews and workshops are generally experienced very positively by the participants. All the participants have indicated that the workshop helped them to gain

Table IV.
Scheduling result, for design alternative d_0 and d_1

Variable	Current (Design alternative d_0) Input value	Current (Design alternative d_0) Scheduling result	Future (Design alternative d_1) Input value	Future (Design alternative d_1) Scheduling result
First-year students in own faculty	Unconstrained	47%	> = 65%	65%
Second-year students in own faculty	Unconstrained	28%	> = 40%	40%
Third-year students in own faculty	Unconstrained	15%	> = 15%	15%
Lectures in evening hours	Not possible	0%	Not possible	0%
Lectures in lunch hours	Not possible	0%	Not possible	0%
Allowed walking distance	Maximum 5 minutes	4.7 minutes on average	Maximum 15 minutes	5.2 minutes on average
New bachelor programs	Off	496 lectures per week	On	425 lectures per week
Amount of options given by teacher	Low	6,830 possible time slots for 496 lectures	High	12,639 possible time slots for 425 lectures
Amount of students	= 100%	–	= 100%	–

Notes: The input value can be changed by the decision-makers to optimise the scheduling result

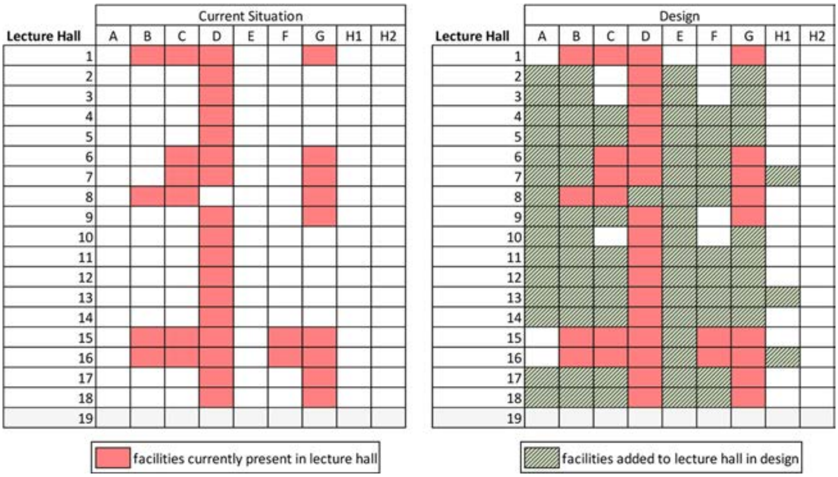


Figure 7. Portfolio result, current and future. The numbers A-H2 correspond with the interventions named above

insight into the problem and their own criteria or those of others. Also, during the workshop, they saw what the effect of their choices was: how the criteria affected the interventions and vice versa. The stakeholders were especially positive about the second workshop: bringing people together, searching together for a good solution, the interaction with each other and the model were all aspects that were rated positively. Some participants also recognised the importance of iteration in the process. The first workshop (for each individual stakeholder group separately) was rated less positively; some participants recognised that they had more time to focus on their own criteria and understanding the model. However, others did not understand the goal of the workshop or missed the discussion with other stakeholders.

The attractiveness of the method is rated highly by the participants. They find the process of interviews and workshops helpful – the interviews are a more attractive way to think about what you want than for example questionnaires, and the workshops are attractive when multiple participants are brought together to discuss the problem. Another attractive aspect is the use of curves. The participants describe determining curves as easy, and one participant remarked that the curves result in fewer emotions in the discussion and more thinking in the collective interest. What is generally found difficult is to assign preference scores; one has to estimate his/her preference when a certain value is achieved. That is why the possibility of adjusting criteria is so important. Designing interventions was perceived more difficult.

When asked about their perception of the method's effectiveness, the participants responded very positively. Some of them think that it helps to reach an agreement on an end result and that they will understand quicker why certain choices are made. When looking at the time spent and the results of the process, most participants respond that the process is certainly efficient compared to others, while some felt it took more time than similar processes.

6.2 Evaluating the PAS design procedure

In Chapters 2 and 3, the research methods chapter, the adaptation of Steps 5 and 6 of the PAS design procedure was discussed. Rather than generating all the portfolio design

Decision-maker	Criterion	d_0	d_1
Board of Directors	Education in small groups	87	100
	Student satisfaction	0	43
	Teacher satisfaction	57	88
	Occupancy rate	100	94
Directors of Education	First year students: lectures in own faculty	40	68
	Second year students: lectures in own faculty	33	70
	Third year students: lectures in own faculty	35	53
	Appropriate classroom size	25	17
	Availability of four-quadrant beamer	0	88
	Availability of blackboard and beamer	79	100
	Availability of flexible chairs	0	69
	Education in small classrooms	–	–
Student Council	Amount of lectures recorded (Collegerama)	0	93
	Amount of lectures in the evening	100	100
	Amount of movements between buildings	66	72
	Lectures in own faculty	0	0
	First year students: lectures in own faculty	–	–
	Second year students: lectures in own faculty	–	–
	Third year students: lectures in own faculty	–	–
	Availability smartboard/four-quadrant beamer	9	56
	Flexible lecture halls	0	69
Teacher	Standard equipment	92	100
	Blackboards/whiteboards	65	100
	Flexible chairs	0	0
	Walking distance for students	100	96
	Amount of lectures recorded (Collegerama)	69	99
	On-site assistance	–	–
	Assistance in transport of teaching materials	–	–
	Reservation of parking spots	–	–
Education and Student Affairs	Walking distance for students	100	98
	Appropriate classroom size	37	25
	Occupancy rate	37	25
	Functionality of lecture hall equipment	–	–
FMRE	Occupancy rate	100	88
	Appropriate classroom size	72	68
	Exploitation costs	–	–
Total		58	69

Table V.
Preference score per criterion; current and future design alternative

alternatives and selecting the best one based on an overall preference scale, the participants were required to design alternatives themselves. In the workshops, the starting point was the current portfolio (design alternative d_0) with overall performance score based on the weighted sum of all the preference scores. The objective was to design the highest possible overall preference score by modifying the real estate objects in the portfolio.

At the outset of the project, our expectation was that this process of self-design would help the participants to better understand the relationship between the design alternatives and their criteria. This was confirmed in the evaluation: the participants indicated that whilst the method of determining preferences is easy, accurately determining which preference is related to a certain value is not. Assigning preference scores to values of, for example, the occupancy rate can be arbitrary at first.

By repeating the cycle of determining preferences and making designs a number of times, the participant can see what the effect of the decisions made in the design is, and how those decisions affect the stated preference. In Figure 8, the development of the criteria (C) and boundary conditions (RV) given by the Student Council are displayed[3]. After Workshop 1, the Student Council participant modified one criterion (C3) and added two new ones (C5 and C6). After Workshop 2, he modified one criterion (C4) and split it into three separate criteria. In both of these examples, the weights between the criteria were also adjusted.

What this demonstrates is that the feedback from self-design helps the users to better understand their input and to improve it. We argue that when using the original PAS design procedure, it is possible to determine the best result by using an algorithm; however, when the algorithm is available, it is also essential that the participants design themselves to better understand the relation between their preferences and the performance of the portfolio. Additionally, by improving the representation of their preferences, the model will better depict the actual situation. The use of such a learning process in the context of work practice and problem-solving is described by Schön (1987) as reflection in action.

7. Conclusion

With regards to the PAS design procedure, the generic objective was to develop a methodology for designing a real estate strategy that incorporates explicit scales for measuring value/preference and enables aggregating individual preference ratings into an overall rating while taking into account both quantitative and qualitative portfolio properties. The results show that the PAS design procedure fulfils the above-mentioned requirements. Users are able to define their criteria and design constraints, assign preference scores, assign weights and make portfolio designs. By repeating the procedure a number of times and by self-designing solutions rather than using an algorithm, the participants improve the representation of their preferences in the model and the quality of the solutions found.

Towards the client, the specific objective was to generate and select solutions to solve the problem of the DUT's lecture halls by using the PAS design procedure. With regards to the lecture hall problem, the results demonstrate that the participating stakeholders each determined criteria and design constraints relevant to them. Then, a model was designed in which the participants could make a design alternative for both the timetable and the real estate portfolio. In the second workshop, they designed an

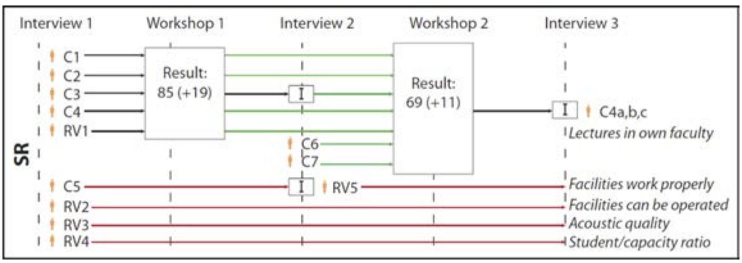


Figure 8.
Development of the criteria and boundary conditions determined by the Student Council (2)

alternative with an overall preference score of 69, compared to a score of 58 for the current portfolio.

The evaluation of the design process was also positive. According to the participants, determining preferences and refining and adjusting them in collective workshops is the attractive part of the method. Understanding the relation between values, preference ratings and one's actual preference is found to be difficult and costs time, but even so participants indicate that they understand quicker why certain choices are made. Not only does the design result improve as result of the workshop but also the participants think the end result is better, and the process to reach that end result is more efficient than comparable processes.

8. Recommendations

The PAS design procedure enables CRE managers to actually calculate the added value of a real estate strategy. This procedure can be used standalone but can also be used in combination with existing CRE alignment. This is an opportunity for future research.

In the evaluation of the pilot study, the participants recommended involving more people in the process, especially students and teachers. Now that the results confirm that people are able to use the PAS design procedure to design more desired real estate portfolio designs, this is a step that can be made. This can be done by collecting criteria and constraints with questionnaires for a wider array of participants, and organizing workshops in a larger setting.

This pilot study has also revealed the possibility of combining the PAS design procedure to design a real estate portfolio in combination with scheduling. In further research, we recommend to improve the scheduling model used to determine the feasibility of the portfolio design. Perhaps, it is also possible to optimise scheduling based on preference measurement.

With regards to the PAS design procedure, further research is needed to explore the differences between the original procedure and the modified version used in this paper. In the evaluation, the importance of self-designing solutions was discussed. However, in the original procedure, there was no design process, as the best design alternative was generated and selected by means of an algorithm. We recommend developing the algorithm and researching the difference in quality of the solution found by the algorithm and the participants.

Finally, the procedure of PAS is generic and can be used for a wide range of problems in real estate portfolios. The more important the preferences of users are for the use of the portfolio, the more relevant a method like PAS becomes – shopping centres, office buildings and gated communities are a few examples of such portfolios.

Notes

1. In this paper, we use both terms accommodation strategy and real estate strategy interchangeably. The term accommodation strategy indicates a more demand, i.e. end-user-oriented strategy, which includes other solutions than real estate solutions. A real estate strategy is more supply driven, i.e. real estate focused. At present, both terms are used while indicating the same.
2. In the mathematical model, the feasible set refers to the set of decision variables that can be set to a value of one. The smaller the feasible set, the less likely it is that the model is able to

generate a feasible solution. In a scheduling model, where there are a lot of constraints, maximizing the size of the feasible set makes it easier to find more desired solutions.

3. In Figure 8, the criteria and boundary conditions of the Student Council are displayed. Each criterion is represented by C1-C7. Each boundary condition is represented by RV1-RV4. A green arrow means that the criterion or boundary condition was incorporated in the model; a red arrow means that it was not incorporated in the model. A box with the letter "I" in it means that a criterion was adjusted in an interview. The figure thus shows that after the first workshop, the Student Council made two changes and added two criteria. After the second workshop, one criterion was split into three separate criteria.

References

Ackoff, R.L. and Sasieni, M.W. (1968), *Fundamentals of Operations Research*, Wiley, Oxford.

Appel-Meulenbroek, R. (2014), "How to measure added value of CRE and building design: knowledge sharing in research buildings", Unpublished thesis, TU Eindhoven, Eindhoven.

Appel-Meulenbroek, R., Gordon Brown, M. and Ramakers, Y. (2010), "Strategic alignment of corporate real estate", *ERES Conference*, *Milan*.

Arkesteijn, M.H. and Binnekamp, R. (2013), "Real estate portfolio decision making", in Gheorghe, A.V., Macera, M. and Katina, P.F. (Eds), *Infranomics: Sustainability, Engineering Design and Governance*, Springer, Dordrecht, pp. 89-99.

Arkesteijn, M.H. and Heywood, C. (2013), "Enhancing the alignment process between CRE and organizational strategy", *Corenet Global EMEA Summit*, Amsterdam.

Barzilai, J. (1997), "A new methodology for dealing with conflicting engineering design criteria", *Proceedings of the 18th Annual Meeting of the American Society for Engineering Management*, Virginia Beach, VA, pp. 73-79.

Barzilai, J. (2010), "Preference function modeling: the mathematical foundations of decision theory", Ehrgott, M., Figueira, J.R. and Greco, S. (Eds), *Trends in Multiple Criteria Decision Analysis*, Springer, New York, NY, pp. 57-86.

Chaffee, E.E. (1985), "Three models of strategy", *Academy of Management Review*, Vol. 10 No. 1, pp. 98-98.

De Jonge, H., Arkesteijn, M.H., Den Heijer, A.C., Vande Putte, H.J.M., De Vries, J.C. and Van der Zwart, J. (2009), *Designing an Accomodation Strategy* (*DAS Frame*), TU Delft Faculty of Architecture, Delft.

Den Heijer, A. (2011), *Managing the University Campus*, Eburon Academic Publishers, Delft.

Edwards, V. and Ellison, L. (2003), *Corporate Property Management: Aligning Real Estate and Business Strategy*, Blackwell Science, Malden, MA.

Englert, J. (2001), *The Strategic Alignment Handbook: A Corporate Infrastructure Resource (CIR) Management Application Guide*, IDRC Foundation, Atlanta.

Gerritse, C. (1999), *Costs and Quality: Steering the Cost-Quality Relationship in the Early Stages of the Accommodation Process*, Delft University Press, Delft.

Haynes, B.P. (2008), "Impact of workplace connectivity on office productivity", *Journal of Corporate Real Estate*, Vol. 10 No. 4, pp. 286-302.

Heywood, C. (2011), "Approaches to aligning corporate real estate and organisational strategy", *ERES Conference*, *Eindhoven*.

ISO (2005), *ISO 9000:2005(en). Quality Management Systems – Fundamentals and Vocabulary*, ISO.

Joldersma, C. and Roelofs, E. (2004), "Impact of soft OR-methods on problem structuring", *European Journal of Operational Research*, Vol. 152, pp. 696-708.

Kaplan, R.S. and Norton, D.P. (2006), *Alignment: Using the Balanced Scorecard to Create Corporate Synergies*, Harvard Business School Press, Boston, MA.

Krumm, P.J.M.M., Dewulf, G. and De Jonge, H. (2000), "What is corporate real estate", in Dewulf, G., Krumm, P.J.M.M. and De Jonge, H. (Eds), *Successful Corporate Real Estate Strategies*, Chapter 2, ARKO Publishers, Nieuwegein.

Mintzberg, H. (1994a), "The fall and rise of strategic planning", *Harvard Business Review*, January.

Nourse, H.O. and Roulac, S.E. (1993), "Linking real estate decisions to corporate strategy", *Journal of Real Estate Research*, Vol. 8 No. 4, pp. 475-494.

Nunnington, N. and Haynes, B. (2011), "Examining the building selection decision-making process within corporate relocations", *Journal of Corporate Real Estate*, Vol. 13 No. 2, pp. 109-121.

O'Mara, M.A. (1999), *Strategy and Place: Managing Corporate Real Estate and Facilities for Competitive Advantage*, The Free Press, New York, NY.

Osgood, R.T. Jr (2004), "Translation organisational strategy into real estate action: the strategy alignment model", *Journal of Corporate Real Estate*, Vol. 6 No. 2, pp. 106-117.

Porter, M.E. (1980), *Competitive Strategy: Techniques for Analysing Industries and Competitors*, Free Press, New York, NY.

Porter, M.E. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, NY.

Porter, M.E. (1996), "What is strategy?", *Harvard Business Review*, November/December, pp. 61-78.

Roulac, S.E. (2001), "Corporate property strategy is integral to corporate business strategy", *Journal of Real Estate Research*, Vol. 22 Nos 1/2, pp. 129-152.

Scheffer, J.J.L., Singer, B.P. and Van Meerwijk, M.C.C. (2006), "Enhancing the contribution of corporate real estate to corporate strategy", *Journal of Corporate Real Estate*, Vol. 8 No. 4, pp. 188-197.

Schön, D.A. (1987), *The Reflective Practitioner: How Professionals Think in Action*, Jossey-Bass, San Francisco, CA.

Snyder, N. and Glueck, W.F. (1980), "How managers plan – the analysis of managers' activities", *Long Range Planning*, Vol. 13 No. 1, pp. 70-76.

Then, D.S.S. (2005), "A proactive property management model that integrates real estate provision and facilities services management", *International Journal of Strategic Property Management*, Vol. 9 No. 1, pp. 33-42.

Then, D.S.S. and Tan, T.H. (2010), "Real estate and facilities management alignment to business needs: a conceptual model", in Wang, Y., Yang, J., Shen, G.Q.P. and Wong, J. (Eds), *International Conference on Construction and Real Estate Management*, *Brisbane*, pp. 33-37.

Van der Schaaf, P. (2002), *Public Real Estate Management: Challenges for Governments*, DUP Science, Delft.

Waring, E. (1779), "Problems concerning interpolations", *Philosophical Transactions Society London*, Vol. 69, pp. 59-67.

Weatherhead, M. (1997), *Real Estate in Corporate Strategy*, Macmillan Press, Houndmills, Basingstoke.

White, A.D. (1998), "Corporate real estate strategies: managing the delivery of optimum solutions", *Journal of Corporate Real Estate*, Vol. 1 No. 1, pp. 64-74.

Wills, P.C. (2005), "Aligning corporate real estate and business strategies", *11th Pacific Rim Real Estate Society (PRRES) Conference*, *Melbourne*.

Further reading

Mintzberg, H., Ahlstrand, B. and Lampel, J. (2001), *Strategy Safari: A Guided tour Through the Wilds of Strategic Management*, 2nd ed., Free Press, New York, NY.

Corresponding author

Monique Arkesteijn can be contacted at: m.h.arkesteijn@tudelft.nl