

## Managing public real estate and the trade-off between supporting user activities and sustainable development

### Case of the Netherlands police

van Staveren, Daniël; Arkesteijn, Monique; Den Heijer, Alexandra

#### DOI

[10.1108/JCRE-08-2023-0031](https://doi.org/10.1108/JCRE-08-2023-0031)

#### Publication date

2024

#### Document Version

Final published version

#### Published in

Journal of Corporate Real Estate

#### Citation (APA)

van Staveren, D., Arkesteijn, M., & Den Heijer, A. (2024). Managing public real estate and the trade-off between supporting user activities and sustainable development: Case of the Netherlands police. *Journal of Corporate Real Estate*, 26(4), 281-308. <https://doi.org/10.1108/JCRE-08-2023-0031>

#### Important note

To cite this publication, please use the final published version (if applicable).  
Please check the document version above.

#### Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

#### Takedown policy

Please contact us and provide details if you believe this document breaches copyrights.  
We will remove access to the work immediately and investigate your claim.

# Managing public real estate and the trade-off between supporting user activities and sustainable development: case of the Netherlands police

Managing  
public real  
estate

281

Received 23 August 2023  
Revised 10 October 2023  
20 November 2023  
Accepted 21 November 2023

Daniël van Staveren, Monique Arkesteijn and Alexandra Den Heijer  
*Department of Management in the Built Environment, Faculty of Architecture,  
TU Delft, Delft, The Netherlands*

## Abstract

**Purpose** – Corporate real estate management (CREM) is complex due to an increasing number of real estate (RE) added values and the tensions between them. RE managers are faced with trade-offs: to choose a higher performance for one added value at the cost of another. CREM research mainly deals with trade-offs in a hypothetical sense, without looking at the characteristics of the RE portfolio nor the specific context in which trade-offs are made. The purpose of this paper is to further develop the concept of real estate value (REV) optimisation with regard to tensions between decreasing CO<sub>2</sub> emissions and supporting user activities.

**Design/methodology/approach** – Mixed method study. REV optimisation between user activities and energy efficiency for police stations in the Netherlands built between 2000 and 2020 is analysed. This is complemented by interviews with an RE manager and senior user of police stations and analysis of policy documents.

**Findings** – The characteristics of the police station portfolio indicate no correlation between user activities and energy efficiency for the case studied. This is complemented by interviews, from which it becomes clear that there was in fact little tension between supporting user activities and energy efficiency. The performances of these two different added values were optimised separately.

**Originality/value** – This study combines different scales (building and portfolio level) with different types of data: portfolio analysis, document analysis and interviews. This creates a comprehensive image of whether and how the Netherlands police optimised the two RE values.

**Keywords** Real estate, Management, Value, Trade-off, Police

**Paper type** Research paper

## 1. Introduction

Real estate (RE) accounts for an estimated 30% of global greenhouse gas emissions and 40% of global energy use (UN, 2016). The UN sustainable development goals concern a

© Daniël van Staveren, Monique Arkesteijn and Alexandra Den Heijer. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at <http://creativecommons.org/licences/by/4.0/legalcode>

This research is funded by the Netherlands Police (NP). The researchers thank the NP for their openness and cooperation during this research. Specifically, the authors thank Louk Heijnders and Li Ling Tjoa for their efforts with regard to this project.



transition to affordable and clean energy and sustainable cities and communities for everyone. To adhere to these goals, governments across the globe adopt policies and laws which move organisations to improve the sustainable performance of their accommodation. Consequently, RE strategies of public organisations increasingly focus on improving the efficiency of the accommodation in terms of energy demand, CO<sub>2</sub> emitted, materials used and the public funds deployed for this. These aspects are commonly referred to as the supply side of accommodation (De Vries, 2006; Den Heijer, 2011). Next to supply-related challenges, public organisations deal with challenges related to the demand side, commonly represented through user goals and organisational goals. Aligning the supply with the demand is one of the core issues in the field of Corporate real estate management (CREM) (Valks, 2021). This also goes for the central case in this study: The Netherlands Police (NP) and police stations built between 2000 and 2020. In The Netherlands, over 200 police stations accommodate police teams who provide critical services to civilians. It is crucial for these buildings to adhere to several goals. For one, law enforcement organisations are increasingly challenged in attracting personnel to guarantee local enforcement (Charrier, 2000). This includes the NP: more than a quarter of the employees are expected to leave the force between 2020 and 2026 (Netherlands Police, 2019). Attractive and well-functioning police stations can contribute to attracting and retaining new personnel. Simultaneously, the NP is confronted with an increasingly stricter government norm regarding CO<sub>2</sub> emissions (Netherlands government, 2020). Finally, the NP has set ambitions regarding efficiency in space use: for police stations, a workplace norm dictates a maximum number of 0.4 workplaces per FTE and 21.5 m<sup>2</sup> gross floor area (GFA) per workplace, plus an additional 3.5 m<sup>2</sup> GFA per FTE. This norm exceeds the police norm for more generic, office-oriented work: 0.7 workplace per FTE. The reason for this difference is that users of police stations are working outside more than other police services (Netherlands Police, 2013). Altogether, these ambitions cause an increasing mismatch in the demand for and supply of police stations. These challenges impose difficulties in strategic decision-making due to potential tensions between RE-added values (Valks, 2021; Den Heijer, 2021).

The purpose of this research is to further develop the concept of real estate value (REV) optimisation with regard to tensions between the REVs decreasing CO<sub>2</sub> emissions and supporting user activities. The following sub-questions are established:

- Q1. Which performance measurement system is suitable to assess the performance of Dutch police stations?
- Q2. What is the correlation between energy efficiency and available floor space for Dutch police stations?
- Q3. Which thresholds for the performance of both sustainability and supporting user activities prevailed during the development of Dutch police stations?
- Q4. How did stakeholders optimise the performance of the two REVs?

The research follows four steps: First, a performance measurement framework is established, including a summary of different REVs based on previous CREM research. Second, the literature is reviewed for possible tensions to occur between REVs. The review brings forward a tension between available space for users and energy efficiency. This tension is selected for the third step: analysis of a database including all Dutch police stations built between 2000 and 2020. The analysis uncovers the correlation between energy efficiency and available user space. Finally, a senior user and RE developer of a recently developed police station were interviewed to uncover how the

REVs were optimised. This is complemented by a document analysis regarding the prevailing policy and RE strategy of the NP.

## 2. Theory

The theory section consists of three parts and answers the first research question. First, a performance measurement system is introduced. Second, an overview of the different REVs is given. Third, the scientific gap is introduced.

### 2.1 Performance measurement system to identify trade-offs

By measuring the performance of several aspects of the same portfolio, the correlation between these aspects can be analysed. This does not tell whether trade-offs are made, but may hint where RE managers have made trade-offs when deciding about the performance regarding different RE values. Thus, a performance measurement framework is established. The use of this framework is to specify abstract concepts using concrete, measurable items (Kroes and Van de Poel, 2015). Thus, it becomes clear what the abstract concept entails, how it can be measured, and, potentially, how a tension with another abstract concept may occur. An example of an abstract concept is “increasing user satisfaction”. The scholars compared in this research (see Appendix 1) specified user satisfaction using 12 different indicators, ranging from measuring complaints and operating expenses of a help desk to the ratio between office space and common areas. This shows that authors think differently about what user satisfaction entails.

Likewise, authors specified other REVs using different measurable items, which are reviewed in this section. The focus of the review is on which system elements authors use to specify abstract concepts (e.g. criteria, values, goals, etc.). The works in Table 1 are reviewed. In Appendix 2, the analysis of how the authors specify abstract concepts can be found.

From the literature, it becomes clear that scholars use combinations of different elements to specify abstract concepts. For example, “organisational performance” is commonly referred to, though some authors refer to “organisational goals”, “organisational objectives” or “strategic objectives/goals”. “Adding value” is most commonly used to describe how RE can enable organisational performance. However, some use “value parameters”, “effects of corporate real estate (CRE)” or “RE strategy”. To specify how value can be added, authors refer to “criteria” or “indicators”. Some refer to a concept such as “flexibility” as an “added value”; others may also specify this as a “criterion”. Some also refer to key performance indicators (KPIs), though it is not made clear what the difference between KPIs and indicators is. The differences in vocabulary could perhaps be explained by the different institutions and times in which the research was conducted.

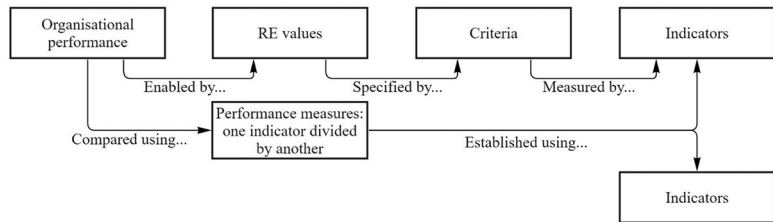
Most scholars do not include a definitions page nor reflect on the terminology of choice. Except for two cases where “indicator” is distinguished from “performance measure” (Lindholm, 2008b; Jensen and Van der Voordt, 2016), indicators are used to measure aspects of RE, while a performance measure is a combination of two indicators set in proportion to one another to compare the performance without clouding the comparison due to specific factors (Ho *et al.*, 2000). For example, “investment costs” per “square meter” can be used to compare RE portfolios of different sizes without distorting the comparison (Kroes and Van de Poel, 2015).

By comparing the terms used by different CREM scholars, this research establishes that, in most cases, the scholars are aligned with the abstract ideas underlying the terms used. Nonetheless, the field lacks a unified vocabulary and performance measurement system. Hence, the measurement framework in Figure 1 is proposed.

**Table 1.**  
works studied to  
define system  
elements for  
performance  
measurement in  
CREM

| Author                                                | Title                                                                              | Institution                                                                       | Publication type |
|-------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------|
| <a href="#">Lindholm, Gibler and Leväinen, (2006)</a> | Modelling the value-adding attributes of RE to the wealth maximisation of the firm | Helsinki University of Technology, Finland                                        | Journal article  |
| <a href="#">Scheffer <i>et al.</i> (2006)</a>         | Enhancing the contribution of corporate RE to corporate strategy                   | University of Twente, Netherlands.<br>Delft University of Technology, Netherlands | Journal article  |
| <a href="#">Appel-Meulenbroek and Feijts (2007)</a>   | CRE effects on organisational performance: measurement tools for management        | Eindhoven University of Technology, Netherlands                                   | Journal article  |
| <a href="#">De Vries (2007)</a>                       | Presteren door Vastgoed                                                            | Delft University of Technology, Netherlands                                       | PhD dissertation |
| <a href="#">Lindholm (2008a)</a>                      | Identifying and measuring the success of corporate RE management                   | Helsinki University of Technology, Finland                                        | PhD dissertation |
| <a href="#">Van der Zwart (2015)</a>                  | Building for a better hospital                                                     | Delft University of Technology, Netherlands                                       | PhD dissertation |
| <a href="#">Van der Voordt <i>et al.</i> (2016)</a>   | Value Adding Management (VAM) of buildings and facility services in four steps     | Delft University of Technology, Netherlands                                       | Journal article  |
| <a href="#">Den Heijer (2021)</a>                     | Campus of the future: managing a matter of solid, liquid and gas                   | Delft University of Technology, Netherlands                                       | Book             |

**Source:** Created by authors



**Figure 1.**  
CREM performance  
measurement system

**Source:** Created by authors

2.2 Added values of real estate

The next step is to inventory the different added values of RE and how they are specified. There is no review paper that can be used to answer this question; however, several works exist which include a dissemination of REV's commonly strived for, including their indicators. Since a systematic literature review is not in the scope of this paper, the most prominent CREM works (see [Table 2](#)) regarding REV and indicators are studied.

The authors together propose 21 different added values of RE, which they defined using 116 criteria (after correction for overlap). To measure the different criteria, the authors propose 68 indicators. The REV's are grouped in [Table 3](#) according to four CREM perspectives ([Den Heijer, 2011](#)): the financial, technical, organisational and functional perspective.

Now that there is an overview of the REVs, the next section answers which tensions have been identified in the literature between these REVs.

### 2.3 Tensions between added values of CRE

Making trade-offs is regarded as a solution to situations where objectives are naturally conflicting and there are no alternatives which satisfy all goals sufficiently. This forces the decision maker to decide which goal to prioritise over the other. Hence, making trade-offs means choosing a higher performance for objective X at the cost of objective Y (Da Silveira, 2005; Keeney, 2002). In this study, this is regarded as REV optimisation. In the literature regarding RE management, different tensions between RE values are mentioned. Jensen and Van der Voordt (2020) propose a total of 22 relationships (either positive or negative) between productivity and 11 other RE values. These, however, are based on estimations by the authors and should be regarded as hypotheses. Shi *et al.* (2016) found a total of 13 tensions between objectives through interviews with 24 construction industry practitioners. The most problematic tension practitioners bring forward is between cost effectiveness and green certification. However, the tension is not specified using criteria or indicators. Likewise, cost effectiveness versus functional effectiveness and demonstration effect are

**Table 2.**  
Works studied to  
establish commonly  
strived for added  
values of RE and  
their measurable  
items

| # | Author                          | Publication type | Year  |
|---|---------------------------------|------------------|-------|
| 1 | De Vries                        | PhD dissertation | 2007  |
| 2 | Lindholm                        | PhD dissertation | 2008a |
| 3 | Den Heijer                      | PhD dissertation | 2011  |
| 4 | Riratanaphong                   | PhD dissertation | 2013  |
| 5 | Van der Zwart                   | PhD dissertation | 2015  |
| 6 | Van der Voordt <i>et al.</i>    | Journal article  | 2016  |
| 7 | Appel-Meulenbroek <i>et al.</i> | Journal article  | 2018  |
| 8 | Amos and Boakye-Agyeman         | Journal article  | 2023a |

**Source:** Created by authors

**Table 3.**  
Added values of RE  
according to CREM  
scholars, categorised  
using the four  
perspectives of  
CREM (Den Heijer,  
2011)

| Financial                                | Supply<br>Technical                                       | Organisational                                 | Demand<br>Functional                                  |
|------------------------------------------|-----------------------------------------------------------|------------------------------------------------|-------------------------------------------------------|
| Controlling risk <sup>3,4,6,8</sup>      | Reducing CO <sub>2</sub> footprint <sup>2,3,4,6,8</sup>   | Improving quality of place <sup>2,3,4</sup>    | Increasing flexibility <sup>2,8</sup>                 |
| Increasing RE value <sup>2,3,4,6,8</sup> | Optimising m <sup>2</sup> footprint <sup>2,3,4,6,8</sup>  | Supporting image <sup>3,5,6,7,8</sup>          | Increasing user satisfaction <sup>2,3,4,5,6,7,8</sup> |
| Reducing costs <sup>2,3,4,5,6,8</sup>    | Reduction of travel and transport activities <sup>6</sup> | Supporting culture <sup>3,5,6,7</sup>          | Community and well-being <sup>4,5,7</sup>             |
| Profitability <sup>1</sup>               | Reduction of waste <sup>4,8</sup>                         | Stimulating collaboration <sup>3,7</sup>       | Supporting user activities <sup>2,3,4,5</sup>         |
|                                          |                                                           | Increasing innovation <sup>3,6,8</sup>         | Productivity <sup>4,6,7,8</sup>                       |
|                                          |                                                           | Quality of CRE organisation <sup>2,4</sup>     | Supporting health and safety <sup>4,6,7,8</sup>       |
|                                          |                                                           | Corporate social responsibility <sup>6,8</sup> |                                                       |

**Notes:** References to the authors (see Table 1) who defined the added values are added in superscript

**Source:** Created by authors

also heavily weighed but not specified. This makes it difficult to understand the nature of the tension. [Oliver et al. \(2019\)](#) present trade-offs more specifically than above-mentioned authors. For example, installing innovative installations to decrease CO<sub>2</sub> emissions requires more specialised operations and maintenance due to errors in the first months of operation of the building. In addition, sustainability measures take up space as a result of internal bike storage, showers to facilitate sustainable mobility and larger mechanical spaces for the geothermal installation. This creates a tension with the available space for occupants of the building. Regarding the occupants, [Van der Voordt and Jensen \(2018\)](#) found that privacy, opportunities to concentrate, perceived productivity and storage facilities are traded-off for an increased efficiency in floor space use due to implemented activity-based work settings.

The theory above shows that, in general, tensions between supply and demand are observed. Organisations pursue financial goals, which in turn pressure the available resources to maximise the REV's. In attempts to maximise the added value within the financial constraints, it would seem that RE managers are faced with tensions between sustainable and functional goals of the organisation. The question is, then, whether that is true for the NP and whether RE managers trade one goal for another and how? Previous work limitedly answers this question: either the tensions are hypothetical, as is the case with [Jensen and Van der Voordt \(2020\)](#) and [Amos and Boakye-Agyeman \(2023b\)](#). Or, when an empirical approach is used, e.g. by interviewing practitioners about the tensions they observe ([Shi et al., 2016](#)), the tensions are described in abstract form, making it difficult to grasp how the tensions are caused. An empirical approach where tensions are specified is lacking, for example, by studying how characteristics of a building or portfolio reflect possible tensions.

This research relies on measurable items instead of abstract concepts and studies the characteristics of police stations in the Netherlands and which policies and RE strategy were in place at that time. Thus, it becomes clear how this context influenced optimisation of the two REV's and which tensions occurred between them.

### 3. Methodology

This research is a mixed method study, relying on qualitative and quantitative data. Both have strengths and weaknesses. A qualitative approach (interviews, in this case) is subject to potential biases of the interviewee ([Queirós et al., 2017](#)). And that which an interviewee may experience may not reflect what the measurable characteristics of a portfolio tell us. Interviews are suited to reflect on the causes behind quantitative data. A quantitative approach has less focus on understanding the context of the problem ([Queirós et al., 2017](#)). This research acknowledges that quantitative and qualitative methods represent two different paradigms. Thus, they are incommensurate, meaning that the researcher should be careful in claiming that both parts are complementary to one another when researching the same phenomenon ([Guba, 1987](#)). Rather, in line with [Sale et al. \(2002\)](#), the two parts of this research are used to study different phenomena, and the outcomes are used to complement both parts. To be specific, quantitative data will allow for an exact performance measurement to indicate where one REV may have been traded for another. And the qualitative data explain the context in which the trade-off was made. First, the quantitative part is performed, from which the results are used to define the scope for the qualitative part.

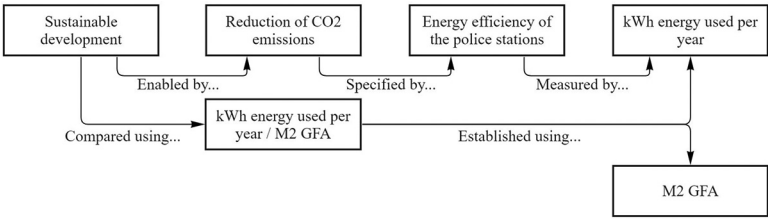
The quantitative part consists of three steps:

- (1) *Database and performance measurement system.* A database was established to measure the performance of all Dutch police stations built between 2000 and 2020. The NP provided access to their accommodation database. For a proper measurement, indicators of interest had to be registered for each police station. This was the case for m<sup>2</sup> GFA, designated full time employees (FTEs) and energy used

(kWh/m<sup>2</sup>) for the year 2021. Other interesting indicators, such as number of workplaces or ratio common space versus office space, were not measured for all police stations. Frontczak *et al.* (2012) found available office space to be the most significant factor for office user satisfaction, for which m<sup>2</sup> GFA per FTE is proposed as a performance measure. This measure is proposed by CREM scholars (Lindholm, 2008a; Van Der Zwart, 2015) and used in practice (see EN15221-7 norm). Indeed, many indicators have been proposed to measure user satisfaction. However, there was no police database available that measures user satisfaction with uniform KPI's other than m<sup>2</sup> GFA/FTE. However, during the interviews, there was room to discuss all possible KPIs brought to the table by the interviewees. To measure CO<sub>2</sub> reduction, yearly kWh used per building is measured (Jensen and Van der Voordt, 2016), again in line with the EN15221-7 norm, which proposes kWh energy used per m<sup>2</sup> GFA. This results in the performance measurement system pictured in Figures 2 and 3.

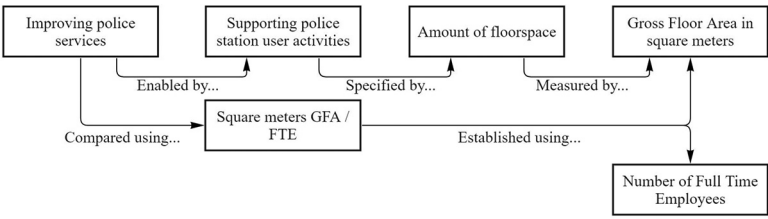
It has to be noted that initially, the ambition was to add a financial indicator to the performance measurement system, since financial and sustainability objectives may be at tension: see Shi *et al.* (2016) and Oliver *et al.* (2019) in the theory section. Despite that the NP manages and monitors investment costs for each project, the indicators to measure financial performance changed over time. Hence, there is no continuous measurement of investment costs for the police stations. Thus, this indicator could not be used for the data analysis:

- (2) *Regression analysis.* To uncover whether a tension possibly exists between the REV's "supporting user activities" and "reduction of CO<sub>2</sub> emissions", a regression analysis was performed using the performance measurement system explained in step 1. The regression may hint at a tension when there is a negative correlation between the two REV's; and



**Figure 2.**  
Performance  
measurement system  
for CO<sub>2</sub> emission  
reduction

Source: Created by authors



**Figure 3.**  
Performance  
measurement system  
for supporting user  
activities

Source: Created by authors

- (3) *Select outliers.* A negative correlation, however, does not prove that trade-offs were made. Therefore, the quantitative findings have to be complemented with information about the CREM context. This is done by selecting outliers, which are buildings with a very high energy efficiency and very low amount of available space per employee. For these outliers, tensions may have been more apparent between the two REV's compared to buildings that perform closer to average on these aspects. To evaluate this, the qualitative part of this research was executed.

The qualitative part consists of the following steps:

- (1) *A document analysis* regarding the policies and strategies that were effective during the development of the police stations. These could influence REV optimisation during the development of the police stations. Two documents were brought forward by a police RE manager involved with RE strategy and policy. And, the business case document for the outlier police station, Venray, was analysed;
- (2) *Interviews.* The data analysis brought forward police stations where, potentially, the two REV's were optimised. One police station was zoomed in on: Venray, for which two interviews were held: one with the responsible RE manager and one with a senior user. This police station is chosen based on the following criteria:
  - A potential trade-off may have occurred between user activities and energy efficiency, based on the data analysis;
  - The police station is developed within the past five years to increase chances of finding interviewees that were involved with the development; and
  - The police station is smaller than the building where the police team transitioned from, increasing the chances of tensions regarding available floor space.

Two outliers passed these criteria: Venray and Uden. However, when an inquiry was made to interview users of the police station in Uden, a police RE manager advised against it, since recently the users had complained about aspects of the police station that had not been built according to expectations. An extra interview initiated by the police RE department would potentially result in annoyance.

Questions used during the interviews included, "the data shows *performance x* for this police station, is that correct in your perception?" and "regarding this *criterion x*, how would you rate the performance and why?". In the last part of the interview, the interviewee was asked to reflect on the question, "were there tensions between the two aspects and if so, were trade-offs made and how?". Prior to the interviews, participants signed an informed consent agreement in line with the EU General Data Protection Regulation.

### 3. Results

The results are presented in the following order. First, research question two is answered by presenting the regression analysis and outliers that indicate a potential tension between the REV's. Second, research question three is answered through document analysis and interviews. Finally, the fourth research question is answered: how did stakeholders optimise the performance of the two REV's?

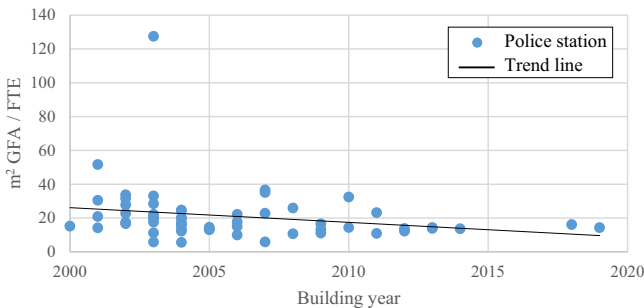
### 3.1 Regression analysis and outliers: energy efficiency and space per employee

The database initially counted 71 police stations, all built between 2000 and 2020. After excluding the buildings that were leased, sold or where data was missing, 57 remained. Finally, a correction was made for 65% of the buildings, since these accommodated other police units in addition to the police team. This distorts the comparison of objects since the norm for a police team was 0.4 workplaces per FTE and for other police units 0.7 (further referred to as the flex norm). After correction, the mean  $\text{m}^2 \text{GFA}/\text{FTE}$  decreased from 25 to 21.3.

The energy efficiency of police stations increased over time, and the amount of square metres per FTE slightly decreased; see also Figures 4 and 5. The average available amount of space per FTE is  $21.3 \text{ m}^2 \text{GFA}$  and the average energy efficiency is  $165 \text{ kWh}/\text{m}^2 \text{GFA}$ .

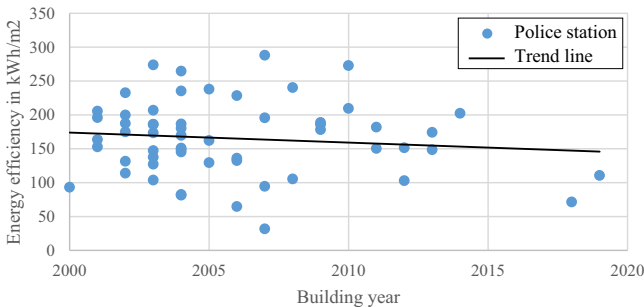
The analysis shows that police stations built after 2010 are more energy efficient, while the same police stations also offer less space per employee (relative to the mean). Also, the nationalisation of the police from 25 self-operating regions to one police organisation in 2013 is reflected in the graphs: policy made police stations more energy efficient, and flex norms prevented the development of new outliers regarding that aspect.

To uncover whether there is a negative correlation between the two aspects (i.e. a potential trade-off was made), a regression analysis is performed. The regression analysis shows that the correlation for two aspects is low to non-existent: 1) the trend line in Figure 6 shows both an upward and downward trend in the same data set (thus, non-monotonic), and



Source: Created by authors

**Figure 4.**  
Space available per  
FTE of Dutch police  
stations



Source: Created by authors

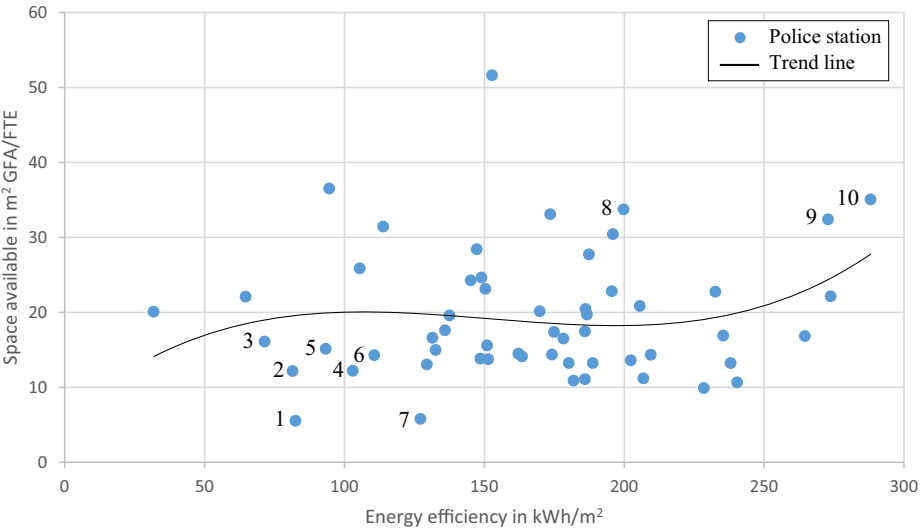
**Figure 5.**  
Energy efficiency of  
Dutch police stations

Figure 6.

Correlation between available space per employee and energy efficiency of Dutch police stations built between 2000 and 2020. The police stations where trade-offs may have occurred are numbered in line with Table 5 and are identified using the Z-score. In favour of the readability of this figure, the police station with a surface area of 120 m<sup>2</sup> per FTE was left out. All other graphs and analysis include this police station

2) the correlation tests presented in Table 4 show that correlation is unlikely. Take note of the difference between the Spearman correlation and the Pearson correlation: one is negative while the other is positive, confirming the non-monotonic relationship. Thus, the data analysis does not suggest a tension between energy efficiency and available space per employee over the years of 2000–2020. To validate this, the research zooms in on particular objects in the next paragraph.

Although the data does not suggest a tension between the two aspects, there are specific police stations of which the characteristics hint at a potential tension. This concerns the objects where the values for both aspects are distributed far from the mean. These outliers were identified using the Z-score, which is an indicator for how far a value diverts from the mean based on the mean and standard deviation of a data set (Kannan *et al.*, 2015). Since a low value in kWh/m<sup>2</sup> actually corresponds with a high performance in energy efficiency, a negative Z-score should be associated with a high performance. Therefore, the sum of the



Source: Created by authors

Table 4.

Indicators for correlation between energy efficiency and available space per employee for Dutch police stations built between 2000 and 2020

| Indicator            | Value  |
|----------------------|--------|
| P-value              | 0.55   |
| Spearman correlation | 0.08   |
| Pearson correlation  | −0.038 |

Source: Created by authors

Z-scores of the two aspects per police station represents potential tensions between the aspects. See Table 5. The complete table is added in the appendix.

For some police stations, the Z-score belonged in the higher or lower ranges, though a tension was less likely since only one of the two aspects performed as an outlier.

Table 5 shows that there are more police stations with a high energy performance and with a lower amount of m<sup>2</sup> GFA per employee, then vice versa. This can be explained by the building years: the later the year, the stricter the building regulations, thus ruling out police stations with an above-average kWh/m<sup>2</sup> energy use after 2000. Before 2000, the data set includes police stations with lower energy efficiency. The police stations presented in Table 4 will be used as a basis to select interviewees for the qualitative part.

### 3.2 Prevailing thresholds for energy efficiency and available floor space for Dutch police stations: document analysis

In 2013, the NP were nationalised into one national police force. Instead of operating through 25 self-managing police regions, one national police-corps was created with unified strategy and policies under which ten regional units and one central unit operate. The organisation is supported by a centralised police services centre and managed by a five-member Force Command with its own support section: the commissioner staff. One of the expected results of the nationalisation was a cost reduction of around €280m over the period of 2013–2025 (after subtracting investments) due to, amongst other, improved efficiency of police accommodation (Netherlands Police, 2012b). At the same time, the NP concluded that police stations are abundant in number (Netherlands Police, 2013). One police team should be accommodated by no more than one police station. This rendered 43 police stations abundant in 2012. To align the number of police stations with policy and strategy, several interventions were proposed:

- concentrate a police team in one of the existing police stations (without investment);
- increase the size of an existing police station to accommodate the police team;
- build or lease a new police station to accommodate the police team; and
- maintain the current situation.

It has to be noted that the strategy to build new buildings is a means to merge two or three regional police teams into one building. The discarded police stations are sold and, in some

| #  | Location    | kWh/m <sup>2</sup> | Z-score kWh/m <sup>2</sup> | m <sup>2</sup> GFA/FTE | Z-score m <sup>2</sup> GFA/FTE | Sum Z-score |
|----|-------------|--------------------|----------------------------|------------------------|--------------------------------|-------------|
| 1  | Rotterdam   | 82.5               | −1.504                     | 5.517                  | −0.954                         | −2.457      |
| 2  | Utrecht (1) | 81.5               | −1.522                     | 12.160                 | −0.551                         | −2.073      |
| 3  | Venray      | 71.5               | −1.704                     | 16.082                 | −0.314                         | −2.017      |
| 4  | Eindhoven   | 103                | −1.131                     | 12.193                 | −0.549                         | −1.680      |
| 5  | Utrecht (2) | 93.3               | −1.307                     | 15.128                 | −0.371                         | −1.679      |
| 6  | Almere      | 127.2              | −0.691                     | 5.776                  | −0.938                         | −1.629      |
| 7  | Uden        | 110.7              | −0.991                     | 14.284                 | −0.423                         | −1.414      |
| 8  | ...         | ...                | ...                        | ...                    | ...                            | ...         |
| 8  | Kerkrade    | 199.8              | 0.629                      | 33.713                 | 0.755                          | 1.384       |
| 9  | Beilen      | 272.9              | 1.958                      | 32.391                 | 0.675                          | 2.633       |
| 10 | Uithuizen   | 288.1              | 2.234                      | 35.040                 | 0.835                          | 3.070       |

**Notes:** The table is sorted by the sum of the two Z-scores, from low to high

**Source:** Created by authors

**Table 5.**  
Selection of police  
stations with an  
inverted performance  
regarding energy  
efficiency and space  
available per FTE,  
using the Z-score

instances, reused by another organisation; however, some are also demolished. To align the supply of accommodation (and other resources) with the demand, including the cost reduction of €280m, an accommodation organisation was initiated. This organisation established several policies that apply to police stations, which can be found in two documents:

- (1) Strategic accommodation plan (SAP) 2013–2025 ([Netherlands Police, 2013](#)); and
- (2) Policy-framework for accommodation (PFA): policy-related principles for the accommodation of the NP ([Netherlands Police, 2012a](#)).

The document analysis is presented from the perspectives of the two REV's this study focusses on: supporting user activities and decreasing CO<sub>2</sub> emissions. And, the documents are scanned for policy regarding the relationship between the two REV's.

*3.2.1 Supporting user activities.* The documents mention this aspect several times. For example, the police set an ambition to realise professional and inspiring working environments with proper working conditions to inspire employees and stimulate an increased operational performance ([Netherlands Police, 2012a](#)). In addition, working spaces have to contribute to meeting each other, communication and collaboration. A specific ambition regarding how police teams work is mentioned: the SAP states that teams will increasingly rely on additional technologies to get in contact with civilians: through internet, or by visiting civilians at their homes. Police employees will be able to work away from the office, and the organisation will be more accessible online ([Netherlands Police, 2013](#)). This ambition brought forward the following norms for the police stations: a maximised flex norm of 21.5 m<sup>2</sup> GFA per workplace and 0.4 workplaces per FTE ([Netherlands Police, 2013](#)). Per FTE, 3.5 extra m<sup>2</sup> GFA was added for specific space used by police teams (locker rooms, holding chambers).

*3.2.2 Decreasing carbon dioxide emissions.* In the documents, CO<sub>2</sub> emissions are not directly referred to. At that time, in the Netherlands, energy efficiency was operationalised by giving buildings an energy label, which represents different factors related to CO<sub>2</sub> reduction. In the SAP and PFA, the following policies were noted regarding energy labels:

- Newly built police stations were required to perform according to energy label A (minimum); and
- Existing police stations were renovated to energy label B. It has to be noted that after 2013, stronger ambitions were set in accordance with technological, legal and societal developments. Currently, the NP aims to realise almost or fully energy neutral police stations ([Netherlands Police, 2022](#)).

*3.2.3 Relationship between carbon dioxide emissions and user activities.* The literature suggests a tension between CO<sub>2</sub> reduction, investment costs and available space for users. And, reducing the available amount of m<sup>2</sup> GFA per employee may result in productivity decrease, but it positively influences investment and exploitation costs. This research poses the question: if the ambition regarding sustainability had been increased from Label A to (almost) energy neutral, did this influence supporting user activities in the form of less space per FTE?

Regarding this, the PFA states that "...investments are aimed at increasing the added value of an object [...] by upgrading or facelifting the object, applying sustainability measures and interventions to adhere to user requirements or being compliant to the law" (PFA, p. 37).

In the SAP, it becomes clear that the savings from realising a more compact police portfolio will be allocated to two types of investments. The first involves investments to transform buildings to be suited for flex-working. This means reorganising floor spaces, including ICT infrastructure, building adaptations, renovations or maintenance (SAP, p. 43).

The second involves investments in new buildings, for which the police relied on an indicative norm regarding exploitation costs of €200/m<sup>2</sup> GFA (SAP, p. 44). Exploitation was the primary indicator to control costs, not investment costs. It is not stated specifically that sustainability measures are included in this norm for exploitation costs.

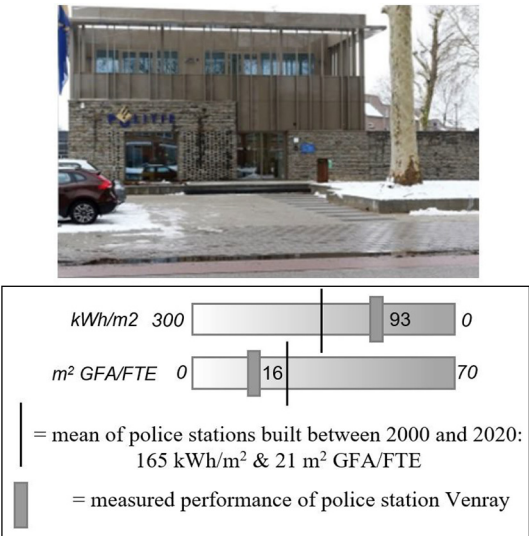
Finally, the SAP states that “trade-offs regarding accommodation will be made transparently and in line with Dutch law by initiating a decision-making process where choices are made between functional requirements, financial costs and gains and added value to society” (SAP, p. 25).

From these documents, it does not become clear which trade-off(s) RE managers were supposed to make between realising financial savings as a result of a more compact portfolio and the sustainability ambitions. As far as the documents go, it seems that the two ambitions are set next to each other. However, the documents do acknowledge that there may be tensions between these aspects and that potentially, RE managers will encounter trade-offs, and that this requires additional decision-making during the development of the project. In the interviews, this research explores whether RE managers were, in fact, confronted with tensions and trade-offs.

### 3.3 Optimising support for user activities and sustainable development: interviews

The findings from the data- and document-analysis are complemented with relevant context-related information, using two interviews: one with the RE manager and one with the team captain of the Venray police team. The RE manager recognises himself in the performance pictured in [Figure 7](#) as well as the findings of the data- and document-analysis:

If we had decided to lower the ambition regarding energy label, this would not have resulted in a higher ambition regarding the space per employee, or other factors influencing user activities.



**Sources:** Created by author. Photo courtesy of the Netherlands Police, permission of use granted for this study. Retrieved from [politie.nl](http://politie.nl), October 2023

**Figure 7.**  
Police station Venray  
with performance  
regarding available  
floorspace and  
energy efficiency

The original police station was 3,000 m<sup>2</sup> GFA, with many personal workspaces isolated from each other in office rooms. The new building would measure 981 m<sup>2</sup> GFA, with open spaces to work in using shared desks. This performance aligns with the policy dictated in the SAP: 0.4 workplace per FTE and 21.5 m<sup>2</sup> GFA per workplace, plus 3.5 m<sup>2</sup> GFA per FTE, which amounts to 992.2 m<sup>2</sup> GFA based on 82 FTE (Netherlands Police, 2015).

The statement of the RE manager was confirmed in the interview with the senior user: according to his experience, supporting user activities was not sacrificed for energy efficiency or vice versa; the REVs had always been discussed separately from each other. They were treated as given norms, dictated by policy. When the interviewee was asked about user activities, it became clear that even though the police station is much more compact compared to the old building, the police team is very satisfied. There were a couple of colleagues unhappy with this building initially because they had to give up their enclosed office space. However, after two months, these persons valued the new police station better than the old. The interviewee stated:

Police officers are recruited based on their ability to connect with others. It is an essential personality trait for police work. Thus, getting rid of the enclosed office spaces actually aligns with why most colleagues choose their profession: they want to work together.

The interview with the team captain is in line with the findings from the document- and data-analysis: energy efficiency was not traded for available space per user or other user criteria, or vice versa. More compact police stations, in combination with other technologies, actually made police services more accessible to civilians and stimulated collaboration; both were used to specify user activities, as this research shows. Thus, optimisation could occur separately from the energy efficiency REV without a disruptive effect. That being said, there is no guarantee that all future police stations will succeed the same way Venray did. The way Venray team lead supported new ways of collaborating, combined with diverse ICT solutions, supported the success of the police station.

#### 4. Discussion

This section discusses the results of this research in light of the scientific gap and practical implications. Two implications are pointed out. While it may seem straightforward that certain tensions arise between REVs, this does not always apply. Context plays a crucial role; it strongly depends on the RE strategy and policy of an organisation. In the case of the NP RE strategy, efficiency and cost reduction were combined with improving police services and energy efficiency, which resulted in fewer and increasingly compact police stations, combined with new ICT technologies and working from other locations. The newer police stations (Venray and Uden) reflect how policy in the form of maximised norms influences their characteristics. In light of the findings of Oliver *et al.* (2019) and Frontczak *et al.* (2012), one could expect that a tension would emerge between sustainability ambitions and supporting user activities. Rather, the tension between user activities and sustainability measures for Dutch police stations seems limited: the main activities of the police officers (patrolling the streets) require less office space. Thus, a compact office did not compromise user activities. This advocates for a thorough understanding of the relationship between RE and user activities; one may, unjustly, conclude that tensions arise and dictate CREM practices based on these false assumptions. Research by Van der Voordt (2004) shows, even for a desk-work focussed organisation, that after renovation, a 30% efficiency gain for available floor space did not result in negative experiences by the users afterwards. In fact, users were satisfied due to improved communication, more advanced ICT and increased appreciation for furnishing. This sheds a new light on the findings of Frontczak *et al.* (2012),

who present available floor space as a KPI for supporting user activities. Certainly, there are thresholds for available floor space that, when exceeded, lead to dissatisfied users. Defining these thresholds could be an issue for future research.

Second, this research further develops the concept of REV optimisation and offers practitioners a case to propose management activities to optimise the trade-off in such a way that the desired performances of RE values are maintained. If not, opportunities to optimise trade-offs may be missed. For example, the Venray senior user had asked for even more sustainability measures than the proposed energy label A: he had asked the RE department to also include infrastructure to charge electric vehicles to be “future proof”. This wish was not granted, according to the interviewee, because of insufficient budget. It is unknown whether this is the result of an intentional trade-off of the RE manager, where cost reduction due to a more compact police station is prioritised over additional sustainability performance. Another reason may be that, in 2015, there was no policy in place for electric vehicles, making it difficult for the RE manager to facilitate this idea. This information could not be retraced and advocates for research not being ex-post as this one, but while RE managers are faced with tensions.

Finally, REV optimization, as seen in the case of the NP poses whether REV's can be treated as linked vessels to optimise trade-offs. The size of the vessels dictate the maximum threshold for the preferred amount of added value. And CREM can indicate what the minimum threshold for added value should be per REV. A vessel can overflow; for example, a building can be built so compactly that an overshoot in cost reduction occurs. Then, CREM can transfer the overshoot in added value from one vessel to another, e.g. towards additional sustainability measures. This way, the trade-off is optimised. Continuing on this line of thought, RE managers can put the user in a position to optimise: how far would they want to prioritise sustainable development over supporting user activities?

## 5. Limitations

The following limitations apply. First, the data set brought forward 10 police stations where, potentially, tensions between user activities and energy efficiency appeared. However, this research could only focus on one police station due to the limited projects built in the past five years. Interviewing more RE managers and users regarding the decision-making during the development of the police stations increases our understanding of whether trade-offs were made. Second, this research focussed on newly developed police stations. It is, however, from a sustainability perspective, pressing to also look at sustainable renovation of existing police stations in relation to supporting user activities. For future research, this is a topic to consider. Finally, it can be debated whether ‘supporting user activities’ is a more appropriate REV to use in this research or “increasing user satisfaction”. The reason to choose for the first is rather simple: two authors use m<sup>2</sup> GFA/employee to specify supporting user activities (van der Zwart, 2015; Lindholm, 2008a), and only author uses this performance measure to specify user satisfaction (Frontczak *et al.*, 2012). That being said, a critical review of “user satisfaction” and “supporting user activities” learns that the distinction between the two REV's is rather weak. The proposed criteria are only partially specified and too diverse. An effort to better distinguish the two REV's would be worthwhile.

## 6. Conclusions

This research further developed the concept of REV optimisation regarding supporting user activities and sustainable development for police stations in the Netherlands. The quantitative results show that there is weak to no correlation between energy efficiency and available square metres GFA per FTE. In addition, the qualitative analysis suggests that

trade-offs between the two aspects were not made: the two ambitions were defined separately from each other, and when one of the REVs were to change due to emerging demands in the project, this did not result in efforts to optimise performance of the two REVs with respect to each other. This research posits that CREM can be improved by treating the added values of RE as communicating vessels. Management activities to define minimum and maximum thresholds regarding added values are necessary to optimise trade-offs in favour of the desired RE performance. Finally, this study shows that whether tensions exist between user activities and sustainable development depends on the type of RE strategy and policy and the type of user activities. These aspects are crucial to take into account by scholars and RE managers who intend to make good trade-offs.

## References

- Amos, D. and Boakye-Agyeman, N.A. (2023a), "Content validation of value-adding indicators for corporate real estate management: insights from a developing country", *Journal of Corporate Real Estate*, Vol. 25 No. 1, pp. 77-97, doi: [10.1108/JCRE-08-2021-0024](https://doi.org/10.1108/JCRE-08-2021-0024).
- Amos, D. and Boakye-Agyeman, N.A. (2023b), "Modelling the added value of corporate real estate on organizational performance", *Journal of Corporate Real Estate*, Vol. 25 No. 4.
- Appel-meulenbroek, R. and Feijts, B. (2007), "CRE effects on organizational performance: measurement tools for management", *Journal of Corporate Real Estate*, Vol. 9 No. 4, pp. 218-238.
- Charrier, K. (2000), "Marketing strategies for attracting and retaining generation X police officers", *Police Chief*, Vol. 67, pp. 45-51.
- DA Silveira, G. (2005), "Improving trade-offs in manufacturing: method and illustration", *International Journal of Production Economics*, Vol. 95 No. 1, pp. 27-38, doi: [10.1016/j.ijpe.2003.10.023](https://doi.org/10.1016/j.ijpe.2003.10.023).
- DE Vries, J. (2007), *Presteren Door Vastgoed*, Eburon Uitgeverij BV.
- DE Vries, J. (2006), "The impact of real-estate interventions on corporate performance", *Conceptual framework and practical examples. 6th Intern. Postgraduate Research Conference, University of Salford*, pp. 518-529.
- DEN HEIJER (2011), *Managing the University Campus: Information to Support Real Estate Decisions*, Eburon Uitgeverij BV.
- DEN HEIJER (2021), *Campus of the Future – Managing a Matter of Solid, Liquid and Gas*, Delft University of Technology.
- Frontczak, M., Schiavon, S., Goins, J., Arens, E., Zhang, H. and Wargocki, P. (2012), "Quantitative relationships between occupant satisfaction and satisfaction aspects of indoor environmental quality and building design", *Indoor Air*, Vol. 22 No. 2, pp. 119-131, doi: [10.1111/j.1600-0668.2011.00745.x](https://doi.org/10.1111/j.1600-0668.2011.00745.x).
- Guba, E.G. (1987), "What have we learned about naturalistic evaluation?", *Evaluation Practice*, Vol. 8 No. 1, pp. 23-43.
- Ho, D.C., Chan, E.H., Wong, N.Y. and Chan, M.W. (2000), "Significant metrics for facilities management benchmarking in the Asia pacific region", *Facilities*, Vol. 18 Nos 13/14, doi: [10.1108/02632770010358088](https://doi.org/10.1108/02632770010358088)
- Jensen, P.A. and VAN DER Voordt, T. (2016), "Facilities management and corporate real estate management as value drivers: how to measure and manage adding value".
- Jensen, P.A. and VAN DER Voordt, T. (2020), "Productivity as a value parameter for FM and CREM", *Facilities*, Vol. 39 Nos 5/6, pp. 305-320, doi: [10.1108/F-04-2020-0038](https://doi.org/10.1108/F-04-2020-0038).
- Kannan, K.S., Manoj, K. and Arumugam, S. (2015), "Labeling methods for identifying outliers", *International Journal of Statistics and Systems*, Vol. 10, pp. 231-238.
- Keeney, R.L. (2002), "Common mistakes in making value trade-offs", *Operations Research*, Vol. 50 No. 6, pp. 935-945, doi: [10.1287/opre.50.6.935.357](https://doi.org/10.1287/opre.50.6.935.357).

- 
- Kroes, P. and VAN DE Poel, I. (2015), *Design for Values and the Definition, Specification, and Operationalization of Values*, Springer.
- Lindholm, A.L. (2008b), "A constructive study on creating core business relevant CREM strategy and performance measures", *Facilities*, Vol. 26 Nos 7/8, pp. 343-358, doi: [10.1108/02632770810877976](https://doi.org/10.1108/02632770810877976).
- Lindholm, A.-L. (2008a), "Identifying and measuring the success of corporate real estate management", *Teknillinen Korkeakoulu*.
- Lindholm, A.-L., Gibler, K. and Leväinen, K. (2006), "Modeling the value-adding attributes of real estate to the wealth maximization of the firm", *Journal of Real Estate Research*, Vol. 28 No. 4, pp. 445-476, available at: <https://doi.org.tudelft.idm.oclc.org/10.1080/10835547.2006.12091187>
- NETHERLANDS GOVERNMENT (2020), "BENG eisen treden van januari 2021 in werking", [Online], available at: [www.rijksoverheid.nl/actueel/nieuws/2020/12/18/beng-eisen-treden-van-1-januari-2021-in-werking](http://www.rijksoverheid.nl/actueel/nieuws/2020/12/18/beng-eisen-treden-van-1-januari-2021-in-werking) (accessed 2022).
- NETHERLANDS POLICE (2012a), "Beleidskader huisvesting: beleidsprincipes voor de huisvesting van de nationale politie".
- NETHERLANDS POLICE (2012b), "Realisatieplan nationale politie", available at: [www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2012/12/07/realisatieplannationale-politie.html](http://www.rijksoverheid.nl/documenten-en-publicaties/kamerstukken/2012/12/07/realisatieplannationale-politie.html)
- NETHERLANDS POLICE (2013), "Strategisch huisvestingsplan 2013-2025: Meer investeren in mensen en betere voorzieningen en in minder stenen".
- NETHERLANDS POLICE (2015), "Business case police station Venray".
- NETHERLANDS POLICE (2019), "Jaarverantwoording politie", 2019 [Online], available at: [www.politie.nl/binaries/content/assets/politie/nieuws/2020/00-km/infographic-politiecijfers-2019-150-dpi.pdf](http://www.politie.nl/binaries/content/assets/politie/nieuws/2020/00-km/infographic-politiecijfers-2019-150-dpi.pdf) (accessed).
- NETHERLANDS POLICE (2022), "Politie verduurzaamt stapsgewijs [online]", available at: [www.politie.nl/nieuws/2022/december/1/00-politie-verduurzaamt-stapsgewijs.html](http://www.politie.nl/nieuws/2022/december/1/00-politie-verduurzaamt-stapsgewijs.html) (accessed).
- Oliver, A., Leoto, R., Lizzaralde, G., Petter, A. and Roy, N. (2019), "Design, decision-making and trade-offs in the Centre for sustainable development (La maison du développement durable) in Canada", *IOP Conference Series: Earth and Environmental Science*, IOP Publishing, p. 12055.
- Queirós, A., Faria, D. and Almeida, F. (2017), "Strengths and limitations of qualitative and quantitative research methods", *European Journal of Education Studies*, doi: [10.5281/zenodo.887089](https://doi.org/10.5281/zenodo.887089).
- Riratanaphong, C. (2013), *Performance Measurement of Workplace Change: In Two Different Cultural Contexts*, TU Delft.
- Sale, J.E., Lohfeld, L.H. and Brazil, K. (2002), "Revisiting the quantitative-qualitative debate: implications for mixed-methods research", *Quality and Quantity*, Vol. 36 No. 1, pp. 43-53, doi: [10.1023/A:1014301607592](https://doi.org/10.1023/A:1014301607592).
- Scheffer, J.J., Singer, B.P. and VAN Meerwijk, M.C. (2006), "Enhancing the contribution of corporate real estate to corporate strategy", *Journal of Corporate Real Estate*, Vol. 8 No. 4, pp. 188-197.
- Shi, Q., Yan, Y., Zuo, J. and Yu, T. (2016), "Objective conflicts in green buildings projects: a critical analysis", *Building and Environment*, Vol. 96, pp. 107-117, doi: [10.1016/j.buildenv.2015.11.016](https://doi.org/10.1016/j.buildenv.2015.11.016).
- UN (2016), *Sustainable Real Estate Investment. Implementing the Paris Climate Agreement: An Action Framework*, United Nations.
- Valks, B. (2021), "Smart campus tools: Technologies to support campus users and campus managers", pp. 1-456, doi: [10.7480/abe.2021.18.6146](https://doi.org/10.7480/abe.2021.18.6146).
- Van Der Voordt, T. and Jensen, P.A. (2018), "Measurement and benchmarking of workplace performance: key issues in value adding management", *Journal of Corporate Real Estate*, Vol. 20 No. 3, pp. 177-195, doi: [10.1108/JCRE-10-2017-0032](https://doi.org/10.1108/JCRE-10-2017-0032).
- Van Der Voordt, T. (2004), "Afstemming op psychologische behoeften", *Inleiding Vastgoedmanagement*, pp. 149-163.

Van Der Voordt, T., Jensen, P.A., Gerard Hoendervanger, J. and Bergsma, F. (2016), "Value adding management (VAM) of buildings and facility services in four steps", *Corporate Real Estate Journal*, Vol. 6, pp. 42-56.

Van Der, Z. (2015), *Building for a Better Hospital: Value-Adding Management and Design of Healthcare Real Estate*, TU Delft, doi: [10.7480/abe.2014.13.787](https://doi.org/10.7480/abe.2014.13.787).

**Further reading**

Appel-Meulenbroek, R., Clippard, M. and Pfnür, A. (2018), "The effectiveness of physical office environments for employee outcomes: an interdisciplinary perspective of research efforts", *Journal of Corporate Real Estate*, Vol. 20 No. 1, pp. 56-80, doi: [10.1108/JCRE-04-2017-0012](https://doi.org/10.1108/JCRE-04-2017-0012).

| Value                                | Criterion                                                                                                                       | Indicator                                                             | Source                                                                                  |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| <i>Financial</i><br>Controlling risk | Technical condition                                                                                                             | % of campus in (very) bad technical condition                         | Den Heijer (2011), Riratanaphong (2013)                                                 |
|                                      | % of portfolio easily sold or disposed of                                                                                       | Market analysis                                                       | Den Heijer (2011), Amos and Boakye-Agyeman (2023a)                                      |
|                                      | Uptime of critical activities                                                                                                   | Uptime of critical activities                                         | Van der Voordt <i>et al.</i> (2016)                                                     |
|                                      | Total risk expenses                                                                                                             | Total risk expenses                                                   | Van der Voordt <i>et al.</i> (2016)                                                     |
|                                      | Total insurance expenses                                                                                                        | Total insurance expenses                                              | Van der Voordt <i>et al.</i> (2016)                                                     |
|                                      | Diversifying (smart location policy; a mix of rent, lease and ownership) when operating as investment                           |                                                                       | Amos and Boakye-Agyeman (2023a)                                                         |
|                                      | Performance assessment of real estate investment                                                                                |                                                                       | Amos and Boakye-Agyeman (2023a)                                                         |
|                                      | Safety in buildings/protocols for fall prevention                                                                               |                                                                       | Amos and Boakye-Agyeman (2023a)                                                         |
|                                      | Future adaptive reuse potential                                                                                                 |                                                                       | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016)                                  |
|                                      | Value of the land property                                                                                                      | Valuation tools                                                       | Den Heijer (2011)                                                                       |
| Increasing real estate value         | Value of the campus buildings                                                                                                   | Valuation tools                                                       | Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a)                    |
|                                      | Cost of new development                                                                                                         |                                                                       | Lindholm (2008a)                                                                        |
|                                      | Business return on real estate assets                                                                                           |                                                                       | Lindholm (2008a)                                                                        |
|                                      | Real estate return on investment                                                                                                |                                                                       | Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                 |
|                                      | Real estate return on equity                                                                                                    |                                                                       | Lindholm (2008a), Riratanaphong (2014)                                                  |
|                                      | Return on property management                                                                                                   |                                                                       | Riratanaphong (2014)                                                                    |
|                                      |                                                                                                                                 | Result before finance cost as percentage of invested capital per year |                                                                                         |
|                                      |                                                                                                                                 | Number of development projects of obsolete properties                 | Lindholm (2008a)                                                                        |
|                                      | Locations for future real estate development that attract value                                                                 |                                                                       | Amos and Boakye-Agyeman (2023a)                                                         |
|                                      | Costs/benefits of proposed projects in comparison with alternatives, using project databases and references on investment level |                                                                       | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a) |
| Reducing costs                       | Effect on organisational costs (personnel) in comparison with alternative projects                                              |                                                                       | Den Heijer (2011)                                                                       |
|                                      | Future expansions based on new business plans                                                                                   |                                                                       | Van der Zwart (2014)                                                                    |
|                                      | Occupancy cost as a percentage of total operating expense                                                                       | Occupancy cost as a percentage of total operating expense             | Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                 |

*(continued)***Table A1.**  
RE values overview

Table A1.

| Value | Criterion                                                                                                                                                                                                                                                                              | Indicator                                                                        | Source                                                                      |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|       | Occupancy cost as a percentage of operating revenue by building or business unit                                                                                                                                                                                                       | Occupancy cost as a percentage of operating revenue by building or business unit | Lindholm (2008a), Riratanaphong (2014)                                      |
|       | Space (square feet or metres) per unit (dollar) of revenue                                                                                                                                                                                                                             | Space (square feet or metres) per unit (dollar) of revenue                       | Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)     |
|       | Total operating expenditures versus budget including general administration, capital expenditures, moves, adds, rearrangements, facility/properties services and other business services (mail and copy centres, risk and/or security). Considering outsourcing vs inhouse FM services | Utility (electricity and water) cost/unit                                        | Riratanaphong (2014), Van der Zwart (2014), Amos and Boakye-Agyeman (2023a) |
|       | Total occupancy cost per employee, including employee behavioral approach to reduce costs                                                                                                                                                                                              | Facility costs (buildings and equipment)                                         | Riratanaphong (2014)                                                        |
|       | Facility management costs (environment, working conditions, quality)                                                                                                                                                                                                                   | Depreciation expense                                                             | Riratanaphong (2014)                                                        |
|       | Investment level that fits the scale of the building                                                                                                                                                                                                                                   | Total occupancy cost per employee                                                | Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)     |
|       | Controlling investment costs and real estate costs                                                                                                                                                                                                                                     |                                                                                  | Riratanaphong (2014)                                                        |
|       | Low initial investment costs                                                                                                                                                                                                                                                           |                                                                                  | Van der Zwart (2014)                                                        |
|       | Sober plans with slim-fit buildings                                                                                                                                                                                                                                                    |                                                                                  | Van der Zwart (2014)                                                        |
|       | Whether workplace standards are used                                                                                                                                                                                                                                                   |                                                                                  | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Occupancy cost per square foot/ metre                                            | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Occupancy cost per dollar/unit of revenue                                        | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Occupancy cost per unit of production                                            | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Occupancy cost as a % of total labour and overhead by business unit              | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Occupancy cost by building                                                       | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Percent of space occupied                                                        | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Percent operational space versus non-operational space                           | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Total owned and leased space (square feet/metres)                                | Lindholm (2008a), Amos and Boakye-Agyeman (2023a)                           |
|       |                                                                                                                                                                                                                                                                                        | Persons per seat                                                                 | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Number of moves per year                                                         | Lindholm (2008a)                                                            |
|       |                                                                                                                                                                                                                                                                                        | Cost of under used space                                                         | Lindholm (2008a)                                                            |

(continued)

| Value                                                        | Criterion                                                                                                                                                        | Indicator                                                                                    | Source                                                                                                                          |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Profitability                                                | Solvability                                                                                                                                                      | Real estate cost per CRE employee                                                            | Lindholm (2008a)                                                                                                                |
|                                                              | Profitability                                                                                                                                                    |                                                                                              | De Vries (2007)<br>De Vries (2007)                                                                                              |
| <i>Technical</i><br>Reducing CO <sub>2</sub> footprint       | Energy use and CO <sub>2</sub> emission (sustainability tools, greencalc, DCBA)                                                                                  |                                                                                              | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016), Riratanaphong (2014), Lindholm (2008a), Amos and Boakye-Agyeman (2023a) |
|                                                              | Consumption of primary energy                                                                                                                                    | Green procurement for real estate life cycle maintenance (LED lighting, etc.)                | Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a)                                                            |
| Optimising m <sup>2</sup> footprint                          | m <sup>2</sup> per function type or user group                                                                                                                   | References on space use from a database                                                      | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016)                                                                          |
|                                                              | Reduced use of natural resources                                                                                                                                 | Number of energy audits<br>Water, gas and electricity consumption in the building operations | Lindholm (2008a), Riratanaphong (2014)<br>Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a)                  |
| Reduction of travel and transport activities<br>Reduce waste | Access to transport                                                                                                                                              |                                                                                              | Van der Voordt <i>et al.</i> (2016)                                                                                             |
|                                                              | Contaminated sites management                                                                                                                                    | Average amount of waste per person                                                           | Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                                                                           |
| <i>Functional</i><br>Increasing flexibility                  | Recycling and treatment of sewage and wastewater                                                                                                                 |                                                                                              | Amos and Boakye-Agyeman (2023a)                                                                                                 |
|                                                              | Multi-functional character of space types                                                                                                                        | Post-occupancy evaluation of space use                                                       | Den Heijer (2011), Amos and Boakye-Agyeman (2023a)                                                                              |
| Increasing user satisfaction                                 | Use by different user groups                                                                                                                                     | Post-occupancy evaluation of space use                                                       | Den Heijer (2011)                                                                                                               |
|                                                              | Separation between supporting structure, filling and expandable zones                                                                                            |                                                                                              | Amos and Boakye-Agyeman (2023a)                                                                                                 |
|                                                              | Rent and short-term lease contracts                                                                                                                              |                                                                                              | Amos and Boakye-Agyeman (2023a)                                                                                                 |
|                                                              | User satisfaction over the years                                                                                                                                 | Post-occupancy evaluation: user satisfaction                                                 | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016), Appel-Meulenbroek <i>et al.</i> (2017)                                  |
|                                                              | Used materials                                                                                                                                                   |                                                                                              | Van der Zwart (2014)                                                                                                            |
|                                                              | Art as part of healing environment<br>Quality of indoor environment (lighting, airconditioning, temperature, noise level, etc.)<br>Provision of safe environment | User satisfaction survey                                                                     | Van der Zwart (2014)<br>Lindholm (2008a), Riratanaphong (2014), Van der Voordt <i>et al.</i> (2016)<br>Riratanaphong (2014)     |

(continued)

Table A1.

Table A1.

| Value | Criterion                                                                                       | Indicator                                                                                                   | Source                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | Location success factors (access to employees, amount of local amenities, access for customers) | Employee attitude survey (perceptions and attitudes related to satisfaction)                                | Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                                                                                                                                        |
|       |                                                                                                 | Ratio of office space to common areas                                                                       | Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                                                                                                                                        |
|       | Provision of amenities                                                                          | Amount of workplace reforms and space modification                                                          | Amos and Boakye-Agyeman (2023a)<br>Riratanaphong (2014)                                                                                                                                      |
|       | Survey rating regarding facilities, building, property management and CRE services              |                                                                                                             | Riratanaphong (2014)                                                                                                                                                                         |
|       | Measured satisfaction with workplaces                                                           | Average call frequency<br>Cost per m <sup>2</sup> help desk                                                 | Riratanaphong (2014)<br>Riratanaphong (2014)<br>Van der Voordt <i>et al.</i> (2016), Den Heijer (2011), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)                                |
|       | Measured satisfaction with collaborative space                                                  |                                                                                                             | Van der Voordt <i>et al.</i> (2016), Riratanaphong (2014)                                                                                                                                    |
|       | Feeling of control                                                                              |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Preferences                                                                                     |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Emotional state, mood                                                                           |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Environmental awareness                                                                         |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Personalisation acts                                                                            |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Employee satisfaction with professional skills                                                  |                                                                                                             | Lindholm (2008a), Riratanaphong (2014)                                                                                                                                                       |
|       | Employee satisfaction with information sharing                                                  |                                                                                                             | Lindholm (2008a), Riratanaphong (2014)                                                                                                                                                       |
|       | Overall tenant satisfaction with property management services                                   | Number of complaints                                                                                        | Riratanaphong (2014)                                                                                                                                                                         |
|       | Average call frequency and cost per square foot (metre)                                         |                                                                                                             | Riratanaphong (2014)                                                                                                                                                                         |
|       | Location success factors                                                                        | Proximity to required transportation modes<br>Access to customers<br>Distance to other sites and businesses | Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a)<br>Lindholm (2008a), Riratanaphong (2014)<br>Lindholm (2008a), Riratanaphong (2014), Amos and Boakye-Agyeman (2023a) |
|       | Crowding                                                                                        |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Privacy feeling                                                                                 |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |
|       | Withdrawal during discretionary periods                                                         |                                                                                                             | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                       |

(continued)

| Value                      | Criterion                                                                                                                                                                                            | Indicator                                                                                                                                      | Source                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Community and well-being   | The contribution to public policy and societal priorities                                                                                                                                            | Percentage of complaints regarding environmental impact                                                                                        | Riratanaphong (2014)                                                                                                                                                                                                                                                                                                                                                          |
|                            | Social behavior, cohesion<br>Well-being (of patients)                                                                                                                                                |                                                                                                                                                | Appel-Meulenbroek <i>et al.</i> (2017)<br>Van der Zwart (2014), Appel-Meulenbroek <i>et al.</i> (2017)<br>Den Heijer (2011)                                                                                                                                                                                                                                                   |
| Supporting user activities | References on similar concepts at other universities: best practices and lessons learned elsewhere (project database with new concepts)                                                              |                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                               |
|                            | Image of the building                                                                                                                                                                                |                                                                                                                                                | Van der Zwart (2014)<br>Van der Zwart (2014), Lindholm (2008a)<br>Riratanaphong (2014)<br>Riratanaphong (2014), Den Heijer (2011), Amos and Boakye-Agyeman (2023a)                                                                                                                                                                                                            |
|                            | Suitability of premises and functional environment<br>Effective use of space (e.g. amount of space, vacancy rates, interruptions due to open space layout)<br>Perceived support to individual output | Square feet per employee<br>Risk Inventory and Evaluation                                                                                      | Riratanaphong (2014), Van der Zwart (2014), Appel-Meulenbroek <i>et al.</i> (2017)<br>Riratanaphong (2014), Van der Zwart (2014)                                                                                                                                                                                                                                              |
| Productivity               | Perceived support to team output                                                                                                                                                                     | Percentage of perceived productivity support from working environment<br>Percentage of perceived productivity support from working environment |                                                                                                                                                                                                                                                                                                                                                                               |
|                            | Performance<br>Organisational effectiveness<br>Turnover<br>Smoothly functioning ICT for property management<br>Facilities maintenance for optimal operations                                         |                                                                                                                                                | Appel-Meulenbroek <i>et al.</i> (2017)<br>Appel-Meulenbroek <i>et al.</i> (2017)<br>Appel-Meulenbroek <i>et al.</i> (2017)<br>Amos and Boakye-Agyeman (2023a)<br>Amos and Boakye-Agyeman (2023a)<br>Van der Voordt <i>et al.</i> (2016), Riratanaphong (2014), Appel-Meulenbroek <i>et al.</i> (2017), Amos and Boakye-Agyeman (2023a)<br>Van der Voordt <i>et al.</i> (2016) |
| Health and safety          | Sick building syndrome                                                                                                                                                                               | Sick leave<br># of accidents                                                                                                                   | Appel-Meulenbroek <i>et al.</i> (2017), Amos and Boakye-Agyeman (2023a)<br>Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                                                                                                                             |
|                            | Stress<br>Arousal<br>Fatigue<br>Sleep quality                                                                                                                                                        |                                                                                                                                                | Appel-Meulenbroek <i>et al.</i> (2017)<br>Appel-Meulenbroek <i>et al.</i> (2017)<br>Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                                                                                                                                                                    |

(continued)

Table A1.

Table A1.

| Value                                        | Criterion                                                                                                                                           | Indicator                                                                                                                                                                            | Source                                                                                                                                             |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Organisational<br>Improving quality of place | Quality before and after                                                                                                                            | Maslow's pyramid with cumulative user needs, connected to investment levels                                                                                                          | Den Heijer (2011)                                                                                                                                  |
|                                              | User requirements and willingness to pay for quality, using project reference database on quality and costs                                         |                                                                                                                                                                                      | Den Heijer (2011)                                                                                                                                  |
|                                              |                                                                                                                                                     | Number of building quality audits and<br>Risk inventory and evaluation<br>Reputation monitor of user group (faculty or university)<br>Project database: reference on image and costs | Lindholm (2008a), Riratanaphong (2014)<br>Riratanaphong (2014)<br>Den Heijer (2011), Appel-Meulenbroek <i>et al.</i> (2017)<br>Den Heijer (2011)   |
| Supporting image                             | Image before and after                                                                                                                              |                                                                                                                                                                                      | Van der Zwart (2014)<br>Van der Zwart (2014)<br>Van der Zwart (2014)                                                                               |
|                                              | Use of buildings as marketing tool by users                                                                                                         |                                                                                                                                                                                      | Van der Voordt <i>et al.</i> (2016)<br>Van der Voordt <i>et al.</i> (2016)<br>Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a) |
|                                              | Used materials                                                                                                                                      |                                                                                                                                                                                      | Den Heijer (2011), Van der Voordt <i>et al.</i> (2016), Appel-Meulenbroek <i>et al.</i> (2017)                                                     |
|                                              | Art as part of healing environment                                                                                                                  |                                                                                                                                                                                      | Den Heijer (2011), Van der Zwart (2014)                                                                                                            |
|                                              | Role of nature in design                                                                                                                            |                                                                                                                                                                                      | Den Heijer (2011), Van der Zwart (2014)                                                                                                            |
|                                              | Perception of corporate identity<br>Perception of corporate value<br>Perception of corporate brand                                                  |                                                                                                                                                                                      | Van der Voordt <i>et al.</i> (2016)                                                                                                                |
| Supporting culture                           | Culture before and after                                                                                                                            | Post-occupancy evaluation                                                                                                                                                            |                                                                                                                                                    |
|                                              | Opportunity costs (related to other ways of supporting culture)                                                                                     |                                                                                                                                                                                      | Van der Zwart (2014)<br>Van der Zwart (2014)<br>Van der Zwart (2014)<br>Van der Zwart (2014)                                                       |
|                                              | Real estate as the outboard engine of the organisation                                                                                              |                                                                                                                                                                                      | Van der Voordt <i>et al.</i> (2016)                                                                                                                |
|                                              | Front-back-office concept                                                                                                                           |                                                                                                                                                                                      | Appel-Meulenbroek <i>et al.</i> (2017)                                                                                                             |
|                                              | The building supports interaction between people                                                                                                    |                                                                                                                                                                                      | Den Heijer (2011), Van der Zwart (2014)                                                                                                            |
|                                              | Improve communication between staff and healthcare professionals<br>Match between culture and work environment<br>Motivation, commitment and morale |                                                                                                                                                                                      | Van der Voordt <i>et al.</i> (2016)<br>Appel-Meulenbroek <i>et al.</i> (2017)                                                                      |

(continued)

| Value                                               | Criterion                                                                                                       | Indicator                                                               | Source                                                               |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------------------------------------------------------------------|
| Stimulating collaboration                           | Multidisciplinary output, before and after                                                                      | Output assessment (before and after)                                    | Den Heijer (2011), Appel-Meulenbroek <i>et al.</i> (2017)            |
|                                                     | Effect on community building, sense of belonging                                                                | Post-occupancy evaluation: user questionnaire                           | Den Heijer (2011)                                                    |
| Increase innovation                                 | Innovation before and after                                                                                     | Output assessment (before and after)                                    | Den Heijer (2011)                                                    |
|                                                     |                                                                                                                 | Level of enclosure/openness                                             | Van der Voordt <i>et al.</i> (2016)                                  |
|                                                     |                                                                                                                 | Average walking distance                                                | Van der Voordt <i>et al.</i> (2016)                                  |
|                                                     | Diversity of meeting and workspaces                                                                             | Emphasis on knowledge work settings, user participation in design phase | Amos and Boakye-Agyeman (2023a)                                      |
| Corporate social responsibility<br>CRE unit quality | Design that allows innovative processes                                                                         |                                                                         | Amos and Boakye-Agyeman (2023a)                                      |
|                                                     | People: diversity of staff                                                                                      |                                                                         | Van der Voordt <i>et al.</i> (2016), Amos and Boakye-Agyeman (2023a) |
|                                                     | Time used in project versus time budgeted for the project                                                       |                                                                         | Lindholm (2008a), Riratanaphong (2014)                               |
|                                                     | Money spent on project versus money budgeted on project                                                         |                                                                         | Lindholm (2008a), Riratanaphong (2014)                               |
|                                                     | Amount advice given to other business units                                                                     |                                                                         | Lindholm (2008a), Riratanaphong (2014)                               |
|                                                     | CRE involved in strategic planning                                                                              |                                                                         | Lindholm (2008a), Riratanaphong (2014)                               |
|                                                     | CRE integrated with HR strategies                                                                               |                                                                         | Lindholm (2008a), Riratanaphong (2014)                               |
|                                                     | CRE actively involved in initiatives such as special asset use, consolidations or shared services opportunities | Percent shared services                                                 | Lindholm (2008a), Riratanaphong (2014)                               |
| Source: Created by authors                          |                                                                                                                 |                                                                         |                                                                      |

Table A1.

Appendix 2

**Table A2.**  
Analysis of RE value  
specification

| Source                                                        | Organisational<br>performance                                    | CRE values                                              | Criteria                          | Indicators                       |
|---------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------|----------------------------------|
| <a href="#">Den Heijer (2021)</a>                             | Organisational goals                                             | Adding value                                            | Assessment<br>criteria, criteria  | Measurable<br>indicators         |
| Lindholm, Karen M.<br>Gibler and Kari I.<br>Leväinen (2006)   | Goals of the firm,<br>objective, organisational<br>objective     | Adding value                                            | –                                 | Key<br>performance<br>indicators |
| <a href="#">De Vries (2007)</a>                               | Organisational goals                                             | Adding value, RE goal                                   | –                                 | Indicators                       |
| <a href="#">Van der Zwart (2015)</a>                          | Organisational goals                                             | Added value                                             | Criteria                          | Performance<br>indicators        |
| Van der Voordt,<br>Hoendevanger,<br>Jensen, Bergsma<br>(2016) | Organisational<br>objectives                                     | Value parameters,<br>added value                        | –                                 | KPI's                            |
| <a href="#">Scheffer <i>et al.</i> (2006)</a>                 | Business objectives,<br>business driving forces                  | Elements of added value                                 | Measurable<br>items               | –                                |
| <a href="#">Lindholm (2008a)</a>                              | Strategic objectives,<br>strategic goals, business<br>objectives | RE strategy                                             | –                                 | Performance<br>measures          |
| Appel-Meulenbroek<br>and Feijts (2007)                        | Organisational<br>performance                                    | Effects of CRE, added<br>value of RE, CRE<br>strategies | Measures,<br>added value<br>types | –                                |
| <b>Source:</b> Created by authors                             |                                                                  |                                                         |                                   |                                  |

| Location            | kWh/m <sup>2</sup> | Z-score<br>kWh/m <sup>2</sup> | m <sup>2</sup> GFA/FTE | Z-score m <sup>2</sup><br>GFA/FTE | Sum<br>Z-score | Potential trade-off<br>unlikely      |
|---------------------|--------------------|-------------------------------|------------------------|-----------------------------------|----------------|--------------------------------------|
| Oosterhout          | 31.8               | -2.4255                       | 20.06976744            | -0.0719868                        | -2.49749       | Available space more<br>than average |
| Rotterdam           | 82.5               | -1.504                        | 5.517                  | -0.954                            | -2.457         |                                      |
| Utrecht             | 81.5               | -1.522                        | 12.160                 | -0.551                            | -2.073         |                                      |
| Venray              | 71.5               | -1.704                        | 16.082                 | -0.314                            | -2.017         |                                      |
| Naaldwijk           | 64.7               | -1.827                        | 22.079                 | 0.050                             | -1.778         | Available space more<br>than average |
| Eindhoven           | 103                | -1.131                        | 12.193                 | -0.549                            | -1.680         |                                      |
| Utrecht             | 93.3               | -1.307                        | 15.128                 | -0.371                            | -1.679         |                                      |
| Almere              | 127.2              | -0.691                        | 5.776                  | -0.938                            | -1.629         |                                      |
| Uden                | 110.7              | -0.991                        | 14.284                 | -0.423                            | -1.414         |                                      |
| Roosendaal          | 129.5              | -0.649                        | 13.029                 | -0.499                            | -1.148         |                                      |
| Pijnacker           | 132.6              | -0.593                        | 14.958                 | -0.382                            | -0.975         |                                      |
| Nunspeet            | 131.5              | -0.613                        | 16.585                 | -0.283                            | -0.896         |                                      |
| Harderwijk          | 105.5              | -1.086                        | 25.852                 | 0.278                             | -0.807         |                                      |
| Emmen               | 136                | -0.531                        | 17.595                 | -0.222                            | -0.753         |                                      |
| Houten              | 148.6              | -0.302                        | 13.820                 | -0.451                            | -0.753         |                                      |
| Wageningen          | 151.4              | -0.251                        | 13.731                 | -0.456                            | -0.707         |                                      |
| Voorburg            | 137.6              | -0.502                        | 19.574                 | -0.102                            | -0.604         |                                      |
| Gorinchem           | 151                | -0.258                        | 15.573                 | -0.344                            | -0.603         |                                      |
| Elst                | 162.2              | -0.055                        | 14.485                 | -0.410                            | -0.465         |                                      |
| Geldrop             | 163.5              | -0.031                        | 14.096                 | -0.434                            | -0.465         |                                      |
| Schijndel           | 94.6               | -1.284                        | 36.508                 | 0.924                             | -0.360         |                                      |
| Assen               | 181.9              | 0.304                         | 10.876                 | -0.629                            | -0.326         |                                      |
| Gieten              | 113.9              | -0.933                        | 31.429                 | 0.616                             | -0.317         |                                      |
| Doorn               | 174.2              | 0.164                         | 14.352                 | -0.418                            | -0.255         |                                      |
| Amsterdam           | 186                | 0.378                         | 11.069                 | -0.617                            | -0.239         |                                      |
| Oud-Beijerland      | 180.2              | 0.273                         | 13.227                 | -0.487                            | -0.214         |                                      |
| Hoogeveen           | 145.2              | -0.364                        | 24.252                 | 0.181                             | -0.182         |                                      |
| Almelo              | 150.4              | -0.269                        | 23.122                 | 0.113                             | -0.156         |                                      |
| Heerenveen          | 149                | -0.295                        | 24.625                 | 0.204                             | -0.091         |                                      |
| Dokkum              | 174.9              | 0.176                         | 17.365                 | -0.236                            | -0.060         |                                      |
| Sprang-Capelle      | 188.8              | 0.429                         | 13.213                 | -0.487                            | -0.058         |                                      |
| De Meern            | 178.3              | 0.238                         | 16.492                 | -0.289                            | -0.051         |                                      |
| Hengelo             | 169.8              | 0.084                         | 20.130                 | -0.068                            | 0.015          |                                      |
| Joure               | 147.3              | -0.326                        | 28.419                 | 0.434                             | 0.108          |                                      |
| Leiden              | 206.9              | 0.758                         | 11.175                 | -0.611                            | 0.147          |                                      |
| Veenendaal          | 186                | 0.378                         | 17.454                 | -0.230                            | 0.148          |                                      |
| Doetinchem          | 202.4              | 0.676                         | 13.581                 | -0.465                            | 0.211          |                                      |
| Burgum              | 186.7              | 0.391                         | 19.706                 | -0.094                            | 0.297          |                                      |
| Terneuzen           | 186.2              | 0.382                         | 20.434                 | -0.050                            | 0.332          |                                      |
| Ter Aar             | 209.5              | 0.805                         | 14.333                 | -0.420                            | 0.386          |                                      |
| Alphen aan den Rijn | 228.5              | 1.151                         | 9.882                  | -0.689                            | 0.462          |                                      |
| Sneek               | 195.6              | 0.553                         | 22.805                 | 0.094                             | 0.646          |                                      |
| Weert               | 205.6              | 0.734                         | 20.829                 | -0.026                            | 0.708          |                                      |
| Leiden              | 240.4              | 1.367                         | 10.643                 | -0.643                            | 0.724          |                                      |

(continued)

**Table A3.**  
Outlier analysis  
Dutch police stations  
built between 2000  
and 2020

| Location         | kWh/m <sup>2</sup> | Z-score<br>kWh/m <sup>2</sup> | m <sup>2</sup> GFA/FTE | Z-score m <sup>2</sup><br>GFA/FTE | Sum<br>Z-score | Potential trade-off<br>unlikely              |
|------------------|--------------------|-------------------------------|------------------------|-----------------------------------|----------------|----------------------------------------------|
| Hoek van Holland | 187.4              | 0.404                         | 27.714                 | 0.391                             | 0.795          |                                              |
| Amsterdam        | 238.1              | 1.325                         | 13.220                 | −0.487                            | 0.838          |                                              |
| Zierikzee        | 173.6              | 0.153                         | 33.067                 | 0.716                             | 0.868          | Energy performance<br>close to average       |
| Deventer         | 235.4              | 1.276                         | 16.882                 | −0.265                            | 1.011          | Available space is low                       |
| Asten            | 196                | 0.560                         | 30.422                 | 0.555                             | 1.115          |                                              |
| Kampen           | 232.6              | 1.225                         | 22.733                 | 0.089                             | 1.315          | Available space<br>performance is<br>average |
| Kerkrade         | 199.8              | 0.629                         | 33.713                 | 0.755                             | 1.384          |                                              |
| 's-Gravenhage    | 264.6              | 1.807                         | 16.810                 | −0.269                            | 1.538          | Available space<br>performance is low        |
| Oostburg         | 152.8              | −0.226                        | 51.611                 | 1.839                             | 1.614          |                                              |
| Amsterdam        | 273.8              | 1.974                         | 22.128                 | 0.053                             | 2.027          | Available space<br>performance is<br>average |
| Beilen           | 272.9              | 1.958                         | 32.391                 | 0.675                             | 2.633          |                                              |
| Uithuizen        | 288.1              | 2.234                         | 35.040                 | 0.835                             | 3.070          |                                              |
| Nieuwendijk      | 103.7              | −1.1183                       | 127.4545455            | 6.4348278                         | 5.31657        | Energy use is low                            |

**Table A3.** Source: Created by authors

**Corresponding author**  
Daniël van Staveren can be contacted at: [vanstaveren.d@gmail.com](mailto:vanstaveren.d@gmail.com)