



Delft University of Technology

## Performance of office buildings from a user's perspective

van der Voordt, DJM; Maarleveld, M

### Publication date

2006

### Document Version

Final published version

### Published in

Ambiente Construido

### Citation (APA)

van der Voordt, DJM., & Maarleveld, M. (2006). Performance of office buildings from a user's perspective. *Ambiente Construido*, 6(3), 7-20.

### 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.

# Performance of office buildings from a user's perspective

*Desempenho de edifícios de escritórios sob a perspectiva dos usuários*

Theo J.M. Van der Voordt  
Maartje Maarleveld

## Abstract

**I**n the field of environmental psychology a long tradition exists in Post-Occupancy Evaluation (POE) or building-in-use studies. Nowadays facility managers and real estate managers seem to show a growing interest in ex post evaluation of buildings, too, particularly in connection to ex ante assessments in the briefing and design phase. The aim of this paper is to discuss general objectives and methods of POE and to show how research findings can be used in (re-)designing and management of office buildings. The approach is illustrated by a case study of an office building of the Dutch Ministry of Agriculture. This building has been assessed by using the WEDI working environment diagnostic tool. The results are used to support decision making in the present renovation of the ministries headquarter in The Hague and the real estate management of other ministerial buildings. The paper ends with a series of lessons learnt from a cross-case analysis of eight office buildings and a preview into work in progress on a search for a satisfaction index that might be used in accommodation policy and for benchmarking purposes.

**Keywords:** *office buildings; post-occupancy evaluation; employee satisfaction; diagnostic tool; cross-case analysis*

## Resumo

*No campo da psicologia ambiental existe uma longa tradição em Avaliação Pós-Ocupação (APO) ou em estudos sobre edifícios em uso. Atualmente, gerentes de facilidades e gestores do mercado imobiliário parecem também mostrar um crescente interesse em APO de edifícios, particularmente em conexão com a Avaliação Pré-Projeto (APP), nas fases de programa de necessidades e projeto. Este artigo tem como objetivo discutir objetivos gerais e métodos de APO e aponta como os resultados podem ser utilizados no (re-)projeto gestão de edifícios de escritórios. A abordagem é ilustrada por um estudo de caso no edifício de escritórios que abriga o Ministério da Agricultura da Holanda. Este edifício foi avaliado através da aplicação da ferramenta WEDI para diagnósticos de ambientes de trabalho. Os resultados estão sendo utilizados para apoiar a tomada de decisão na presente renovação das sedes dos ministérios situadas em Haia e na gestão imobiliária de outros edifícios ministeriais. Ao final, são apresentadas diversas lições apreendidas da análise cruzada de oito edifícios de escritórios e uma descrição preliminar do trabalho que está sendo desenvolvido para definir um índice de satisfação que pode ser usado na política de acomodação e para a realização de benchmarking.*

**Palavras-chave:** *edifícios de escritórios; avaliação pós-ocupação; satisfação dos funcionários; ferramenta de diagnóstico; análise cruzada*

Theo J. M. Van der Voordt  
Faculty of Architecture  
Delft University of Technology  
P.O. Box 5043, 2600 GA Delft,  
the Netherlands  
Phone number +31 15 278 2974  
Fax Number +31 15 278 3171  
E-mail:  
D.J.M.vanderVoordt@tudelft.nl

Maartje Maarleveld  
Organisation and Management  
Centre for People and Buildings  
Delft, the Netherlands  
Phone number +31 15 2783379  
E-mail:  
M.Maarleveld@tudelft.nl

Recebido em 10/04/06  
Aceito em 25/08/06

## Building performance evaluation

Taken literally, evaluation means determining a value, establishing what something is worth. Originally the term came from the financial world, where evaluation means calculating a rate of exchange, determining the value of money. In the world of architecture evaluation is mainly concerned with establishing the architectural, functional, technical and economic value of the built environment (*product evaluation*) or the process of briefing, design, construction and management (*process evaluation*). Evaluations can be done for different reasons and for different target audiences, differ in breadth and depth, method of evaluation, time of evaluation and the people involved in the evaluation. All these points need to be considered when preparing an evaluation. In other words, there must be as clear a picture as possible of what is to be evaluated, why, how, when, for whom and by whom (VOORDT; WEGEN, 2005). For instance, product-related evaluations can deal with matters like the main functional or spatial concept, the program of requirements, a plan or design, a specification or a building as realised. An evaluation may for

example check a program of requirements to see that it corresponds with the desires and requirements of present and future users, with legislation and regulations, with results produced by research and with the budget. These factors are just as relevant when a plan is being evaluated. From an architectonic point of view, a primary evaluation criterion is visual quality or, in more general terms, architectonic quality, as a synthesis of form, function and technology. Evaluation of a design is referred to as *evaluation ex ante*, evaluation before the event, i.e. before the building is realised. It could be thought of as an evaluation of a 'model' of the building, whether on paper, in the form of a scale model or a computer model, or - in the case of building components - a full-scale mock-up. A term used in the American literature is 'pre-design research'. Another term is 'impact assessment'. A well-known example is the environmental effect report, in which a plan is examined for its possible effect on the environment, often in comparison with the null option, i.e. doing nothing, and other variants of the plan.

	Ex ante	Ex post
<b>Product</b>	<p>Does the brief give a clear and complete account of the required or desired user quality, visual quality and technical quality?</p> <p>Do the requirements correspond to the wishes of the users?</p> <p>Can the design be expected to lead to a usable building?</p> <p>Does the design have sufficient visual quality?</p> <p>Is the design affordable?</p> <p>Does the design conform to the building regulations?</p>	<p>Is the building being used in the way anticipated by the client and the architect?</p> <p>Are the users satisfied?</p> <p>How does the actual energy usage compare with the usage estimated in advance?</p> <p>What do experts and laymen think about the building's architectonic quality?</p> <p>Does the building conform to accepted quality standards?</p>
<b>Process</b>	<p>Who should be involved in the process, with which tasks and responsibilities?</p> <p>What input is required from user participation?</p> <p>How much time will be needed for the programming phase, design, contracting out and execution?</p> <p>What information is needed, by whom and when?</p> <p>What tools are available to ensure that the process runs efficiently and effectively?</p> <p>What factors might affect the success or failure of the process?</p>	<p>How was the decision-making organised?</p> <p>Who took what decisions, when, on the basis of what information?</p> <p>How long did the process take, in total and by phase?</p> <p>What tools were used to prepare the brief, to develop and test plan variants, to coordinate different activities and to monitor cost and quality?</p> <p>What was done well and what went wrong?</p> <p>What lessons can be drawn?</p>

Figure 1 - Sample questions for the evaluation of buildings

Evaluation after the event, when the building has been completed and is in use, is referred to as *ex post evaluation*. When the focus is on utility value and experiences of the users, terms such as post-occupancy evaluation (POE) or building-in-use studies are widely used (PREISER et al., 1988; BOARDAS; LEAMAN, 2001). In case of a wider scope, including technical and economic issues, a common term is Building Performance Evaluation or BPE (PREISER; VISCHER, 2005). The distinction between *ex ante* and *ex post* can also be drawn for process-related evaluations. A process-related evaluation can be concerned with the building process as a whole, from initiation all the way through to use and management, or to elements in that process, e.g. the design process. Figure 1 gives some examples of research questions for both *ex post* and *ex ante* evaluation of buildings and building processes.

## Why evaluate?

Evaluation allows lessons to be learnt which can lead to an improvement in the project under investigation and more generally improve the quality of programming, designing, building and managing of the built environment. The reasons for the exercise can be both ideological and economic, for example the promotion of health and welfare or a reduction in the amount of property standing empty in an expanding market. Besides such practical goals, there can also be scientific goals, such as contributing to the formation of new theories or developing new tools (VOORDT; WEGEN, 2005).

## Testing aims and expectations

People involved in the planning process have all kinds of wishes and expectations relating to 'their' building. The user wants a building that is usable and performs the functions for which it was intended but also one that is good to look at and pleasant to be in or to visit. The client has similar wishes, but will often be unwilling to pay more than was budgeted in advance. He may possibly also want the building to contribute to a corporate identity, or to serve as an example in the field of sustainable building. A designer will often set himself the goal of erecting a building that is functional and attractive but also sufficiently original to attract attention in architectural discussion. Thus everyone participating in the building process has his own aims and expectations. *Ex ante* evaluation enables an estimate to be made of the likelihood that these aims will be achieved, which aims may conflict with one another, what program or design concept has the greatest chance of success and how to

reduce the risks of failure. *Ex post* evaluation establishes whether expectations were fulfilled and aims actually achieved. Besides checking against explicitly formulated aims and expectations, evaluation can also bring to light unintended and unforeseen phenomena, positive and negative. A critical evaluation can give an insight into strengths and weaknesses, opportunities and threats (SWOT-analysis).

## Understanding of decision-making processes

Decisions are often based on a wide variety of different considerations. The role played by emotions, intuition, judgments and prejudices, social ideals and norms and values is at least as important as that played by rational argument. Evaluation of a building or a design process can lead to a better understanding of the motives underlying the decisions and roles of the various participants. Such understanding is also important to the interpretation of the result of a product evaluation and the design guidelines and policy recommendations derived from it (ZIMRING, 1988). Points requiring attention include the significance of research in decision-making, the use of tools, the influence of limiting preconditions and the resolution of conflicting interests. There is also a psychological reason for evaluating a building or the process which led to its creation. Renovation or constructing new buildings is exciting, but can also involve a good deal of stress. Everyone involved will have spent a good deal of time and energy searching for optimal solutions consistent with the budget, reaching compromises, moving and rearranging etc. Scheduling an opportunity for evaluation will allow people to let off steam and express their enthusiasm or dissatisfaction.

## Input to running or new decision-making processes

The results of an evaluation can be applied in various ways. *Ex ante* evaluation of a program or design can allow bottlenecks to be identified in good time. Careful evaluation will increase the likelihood of successful decisions and a positive return on investment. Changes are often easier and less expensive in the program or design phase than improvements after the event. The same applies to the organisation of the building process. Once a building is complete, the results of a project-oriented *ex post* evaluation can be used to solve teething troubles and to suggest minor adjustments or radical improvements. Depending on the problems identified, possible solutions might be functional (splitting or combining rooms, adding

lifts), technical (better maintenance, different technical services, insulating the elevations), social (changing the target group, moving personnel internally) or involve adjusting the price/performance ratio (e.g. by reducing the rent). If there is a major mismatch between supply and demand, renovation or replacement by a new building or moving to better premises might be the best solution. Lessons learnt from ex post evaluations can also be used as an input in ex ante evaluation of new projects in order to avoid big mistakes and to support evidence based decision-making (Figure 2).

### Theoretical development

Apart from allowing optimisation of the building under evaluation, there are other higher-level arguments in favour of evaluation, above and beyond the individual project. Evaluation makes it possible for others to learn from one's own experiences during the construction process and in the use and management phase. Individual evaluations and comparisons with other buildings and planning processes can make a significant contribution to theoretical development and the testing of existing theories, e.g. the relationship between the arrangement of the built environment and human behaviour and experience, or between design decisions and design quality, cost, and environmental impact.

### Tools, design guidelines and policy recommendations

Nothing is as practical as a good theory. Knowledge and understanding are essential preconditions for well-considered decisions. But the results of building performance evaluation need to be 'translated' into a form which will be quickly and easily accessible to clients, designers, consultants, policy makers, real estate and facility managers and other stakeholders in the building process. Results may be presented in forms such as checklists, design guidelines, seals of approval and manuals. Tools of this kind turn out to be highly suitable for developing and checking building plans, avoiding disasters, guiding policy and developing legislation and regulations.

### Database of reference projects

Systematic documentation of the findings of evaluation investigations can lead to the creation of a database of interesting projects, containing a number of key items of information about the project and the findings of the evaluation. Modern technology allows the results of research to be stored on a computer and linked with drawing and analysis software.

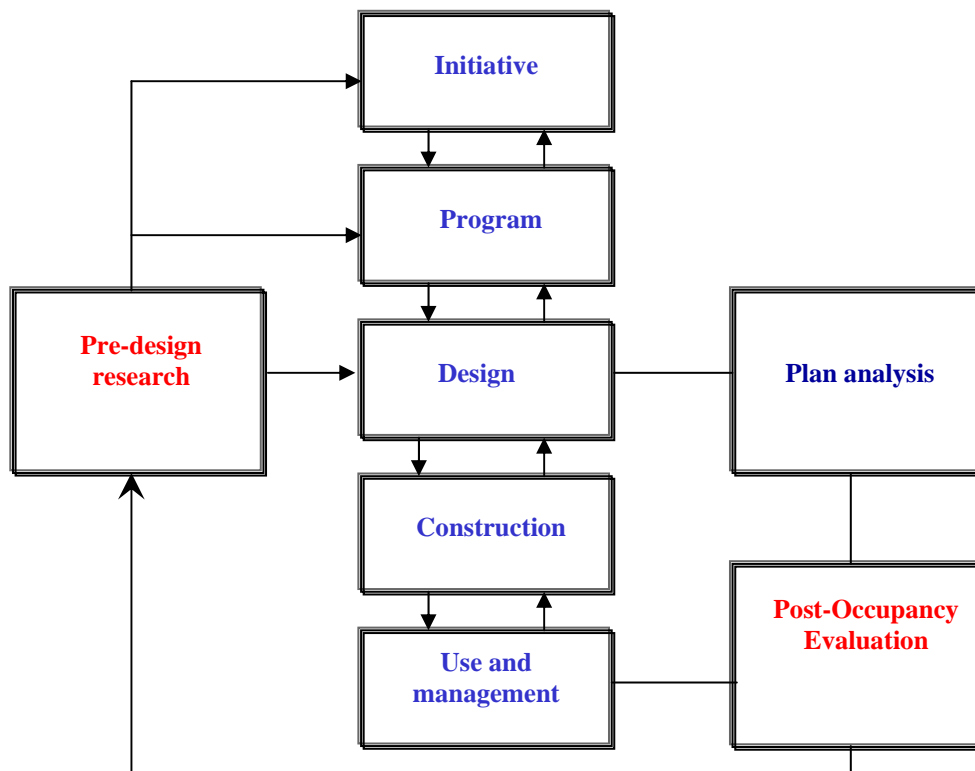


Figure 2 - Feedback and feed forward of ex ante and ex post evaluation

## Research methods

In general, it is not difficult to measure unambiguous descriptive building statistics such as date of construction, gross floor area or the colour of an elevation. But quality criteria can be rather more complex to determine. How for example does one measure user quality, efficient use of floor space, or flexibility? A clear description of the concept is insufficient. Abstract concepts of this kind need to be made more concrete by translating them into variables that can be measured. For example, if we want to measure the flexibility of a building, we could define the concept of flexibility as 'the extent to which the building allows changes in the organisation to be dealt with without having to break down walls'. The next step is to establish which variables are relevant to flexibility as defined in this way, e.g. the nature of the load-bearing structure and the grid size (important to how easy it will be to rearrange the building), polyvalent room boundaries (sliding doors, folding partitions) or the level of division flexibility (demountable or removable walls). Finally it must be possible to justify the way in which concrete variables are measured. If there is no obvious way to carry out a quantitative measurement, the only alternative is to resort to qualitative description. Possible indicators for measuring utility value are for instance:

- (a) The use actually made of rooms and facilities (frequency of use, nature of use: for what activities, individual or communal, for one function or many);
- (b) Valuation given by daily users, absolute and relative to alternative solutions;
- (c) Valuation given by the designer and others involved: the client, owner, manager and consultants;
- (d) Changes made to the building since delivery;
- (e) Figures of rents, unoccupied periods, waiting lists;
- (f) Tendency to move; and
- (g) Figures on maintenance, vandalism and burglary.

Every method of measurement - interviews, questionnaires, observation, experiments and the use of measuring equipment - has its advantages and disadvantages. It is therefore sensible to use several methods in parallel. The choice of method depends in part on the desired breadth and depth of the evaluation and limiting factors such as time, money and expertise. The demands imposed by a "quick and dirty" general diagnosis are different from those imposed by a scientific investigation.

The accepted requirements for scientific research are objectivity, verifiability, validity and reliability. For detailed criteria for scientific exercises and different methods of measurement the reader is referred to the literature on research methodology. Apart from general introductions to research methodology, literature is available which is specifically geared to architecture (e.g. ZEISEL, 1981; BECHTEL et al., 1987; BAIRD et al., 1994; VOORDT; WEGEN, 2005).

## Evaluation of office buildings

In the last decade we have seen a growing interest in new office concepts, which fit better with organisational changes such as less hierarchical organisational structures, a growing number of part-time workers and new ways of working, and the need for a more effective and efficient use of office space. Currently there is a clear rise in the number of non-territorial 'flexible' office designs, based on job functions and work processes rather than on individually assigned workstations. Such innovations in workplace design are intended to facilitate organisational change, improve user satisfaction and labour productivity (particularly by better communication and co-operation), improved flexibility of use of space, and a reduction of facility costs. Internationally these trends have been described and investigated by a number of people, such as BECKER; JOROFF (1995), DUFFY (1992, 1996), BECKER; SIMS (2001), BECKER (2004), and WORTHINGTON et al. (1997, 2005). In the Netherlands a few case studies of new offices have been executed by the team of Prof. Hans de Jonge, chair of the Department of Real Estate & Housing at the Faculty of Architecture of the Delft University of Technology. See for instance VOS (1997-1999), VOORDT; MEEL (2000), VOS; VOORDT (2002), and MALLORY-HILL et al (2005). In 2001 the Delft University of Technology, the Governmental Building Agency and ABN AMRO Bank founded the Delft Centre for People and Buildings. The focus of this knowledge centre is on research and dissemination of knowledge in the field of people, work and working environments. In 2003 a book was published with a state of the art of research into the costs and benefits of innovative workplace design (VOORDT, 2003). Furthermore a series of case studies is executed into both traditional and innovative office buildings (VOORDT et al, 2006). The aim of these case studies is to build up a database for cross-case analyses as an input to decision making processes and "evidence based reasoning" (PULLEN, 2005). As an illustration we will describe one of these case studies: the motive to this study, its aims, methods, results and implementation.

## The Dutch Ministry of Agriculture: a social basis for innovation?

In the period 2005-2007 the main building of the Dutch Ministry of Agriculture in The Hague is being renovated (Figure 3).

As part of the renovation process, the Centre for People and Buildings has executed a Post-Occupancy Evaluation of the present building (MAARLEVELD; VOORDT, 2006). One of the goals of the research was to learn which characteristics of the building and other facilities should be continued after renovation, which issues should be improved, and to which degree changes aimed at by its management might evoke resistance. At this moment the main office concept is a cellular office with personal desks. The ministry will introduce a modest way of desk-sharing and desk-rotating along a variety of workplaces based on their work tasks. Some of the research questions focus on the employees' attitudes towards this type of flexible working. Furthermore the research data will be used for further development of the present strategic real estate policy, both in The Hague and in other buildings of the Ministry elsewhere.

### Research methods

The research has been executed with the help of WEDI, a diagnostic tool that has been developed by the Centre for People and Buildings for evaluating the performance of working environments (VOLKER; VOORDT, 2005a). This tool is an extension and an improvement of a questionnaire that was developed earlier by VOS, DEWULF (1999). The WEDI-tool provides protocols for interviews with key persons, questionnaires to ask employees about their experiences, observation methods to list the actual use of the environment, and a framework to analyse facility costs and savings that have been attained by an efficient use of space and facilities. Three introductory modules guide the client in choosing the scope of the evaluation, the objectives, research methods and prerequisites with respect to time and money, leading to an evaluation study that suits the conditions of the organisation (Figure 4). The point of departure of the evaluation is the preliminary objectives set for the work environment, e.g. "better communication and collaboration", "improving labour productivity", "easier attraction and retention of employees and clients", or "reduction of the facility costs". The next three modules collect facts and figures about the organisation, working processes and facilities, in order to be able to assess the suitability of the

accommodation for this particular organization and its working processes. Six modules have been set up in order to measure the way in which the work environment is experienced and used, and how employees perceive the effect of the physical environment on their labour productivity. In addition there are two modules for measuring the operating results and the facility costs, and two modules for measuring the future value, i.e. future developments and flexibility. The final module deals with the implementation process. A process evaluation of how employees judge issues such as information and participation in the implementation process is important for determining the extent to which the use and experience of the accommodation have been influenced by the method of implementation.

In the report that is set up as a guide how to use the WEDI-tool (VOLKER; VOORDT, 2005b), each module includes instructions for use accompanied by a little theory, a brief discussion of the relevance, a description of possible measurement methods and questionnaires for oral and written interviews. The labour productivity module, for example, starts with a brief analysis of what precisely labour productivity means, what physical environmental variables exert a particular influence on it and how labour productivity may be measured. Since this is particularly awkward in knowledge organizations the focus is on perceived labour productivity, i.e. productivity as experienced by the management and employees. The interview protocol starts with an open question: "How do you consider that the accommodation and other facilities contribute towards labour productivity? Positively or negatively? Why?" Questions are then asked about the assumed effect of a number of environmental factors, including job-rotation, the flex-factor i.e. the number of workspaces per employee, the transparency of the environment, and network facilities, etc. The questionnaire for the employees includes such questions as: How well does the work environment support work requiring concentration and communication with colleagues and external parties? How well does your work environment support office work, telephoning, formal and informal consultation and filing? To what extent do you agree with the following propositions? In addition to 5-point scales for separate issues, 10-point scales have been used to assess employees' overall judgments of the organisation, the working processes, the accommodation, the facilities, and the implementation process.



Figure 3 - Exterior of the Ministry of Agriculture building

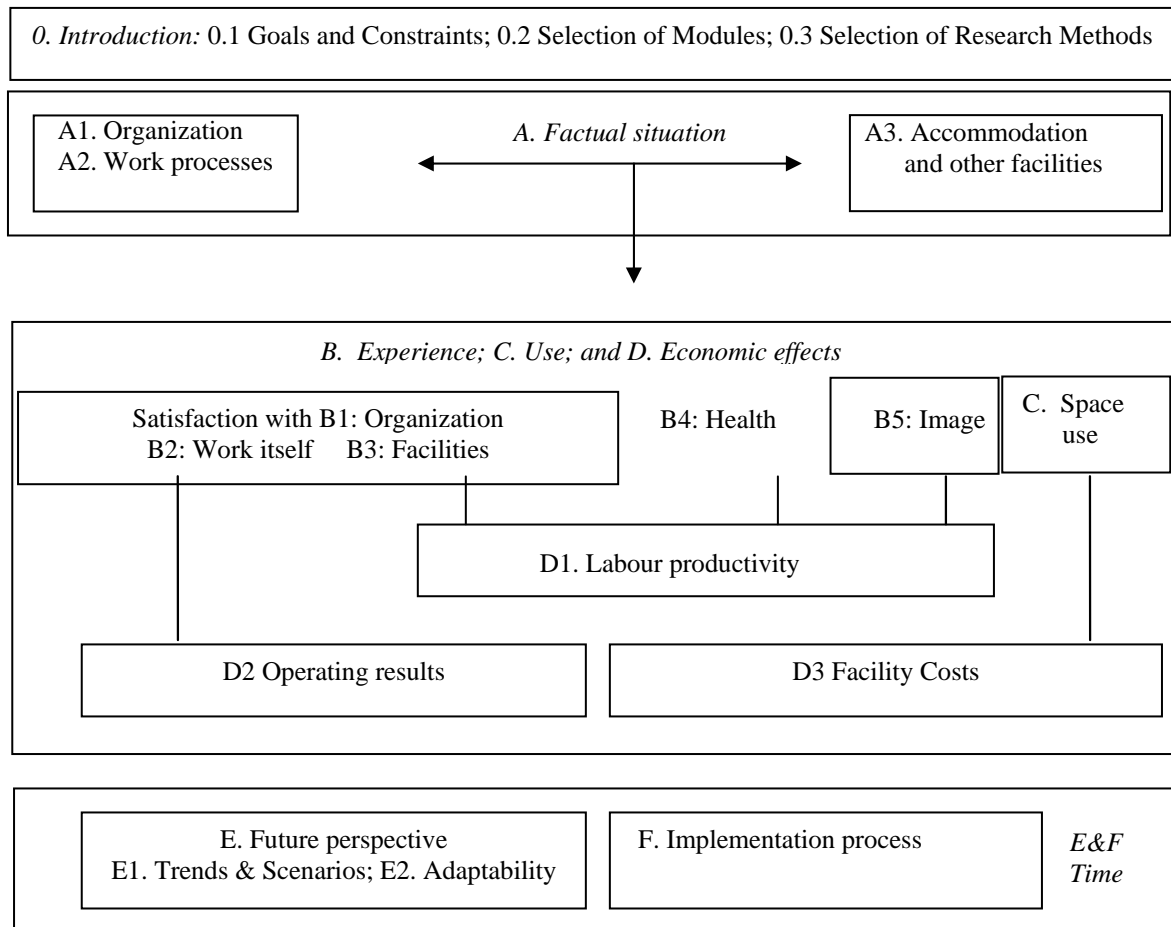


Figure 4 - Modular structure of the WEDI-tool



## Research findings

Because of the focus on user experiences, the modules for measuring the operating results, the facility costs, and the future value (future developments, flexibility) have been excluded from the POE of the building that is discussed here. The questionnaire has been disseminated among all 854 employees. The response was 35%.

Staff devotes approximately half their time to desk-based work, approximately 25% to personal consultation, and approximately 10% to making or receiving telephone calls. They wish to be able to concentrate fully for approximately half of their time. One in four office workers state that they work at home now and then. However, the proportion of staff wishing to do so is very much greater. The average rating for the organisation and the work process is just over seven. The lowest ratings are for 'pressure of work', 'learning from each other', 'ability to concentrate' and 'accessible by telephone' (both of the respondents themselves and of colleagues and external contacts). In no case is the percentage of dissatisfied staff above 20%. Over 80% are satisfied with the work itself, the agreements regarding smoking, social contacts and electronic communications facilities.

The average score for the appreciation of the accommodation concept is 6.4, while that for the general facilities is 6.5. Over twenty per cent of

respondents expressed dissatisfaction with regard to more than one aspect (see Figures 5 and 6).

The lowest scores are achieved by office layout and furnishings, (availability of) meeting rooms and auditive privacy. Facilities which score poorly include cleaning and housekeeping, copying machines, printers and fax, and the archive. The score for the reception facilities is extremely high, achieving a 90% satisfaction rating. The image of the existing building is seen as extremely poor. Although the building is considered appropriate to the organisation, staff does not regard the office layout and furnishings as providing an inspirational setting of which they can be proud. They do not find the office to be particularly attractive for staff or visitors, and believe that it is unlikely to appeal to potential staff.

The support to productivity provided by the working environment achieves an average score of 6.2. A substantial proportion of staff is dissatisfied with regard to the opportunities for concentration, the incentives to quality, and the incentives to communication and exchange of knowledge with colleagues. One in four state that the working environment does not contribute to the welfare and well-being of staff. Just over 20% are dissatisfied with the facilities for communication with external parties and for formal negotiation or meetings.

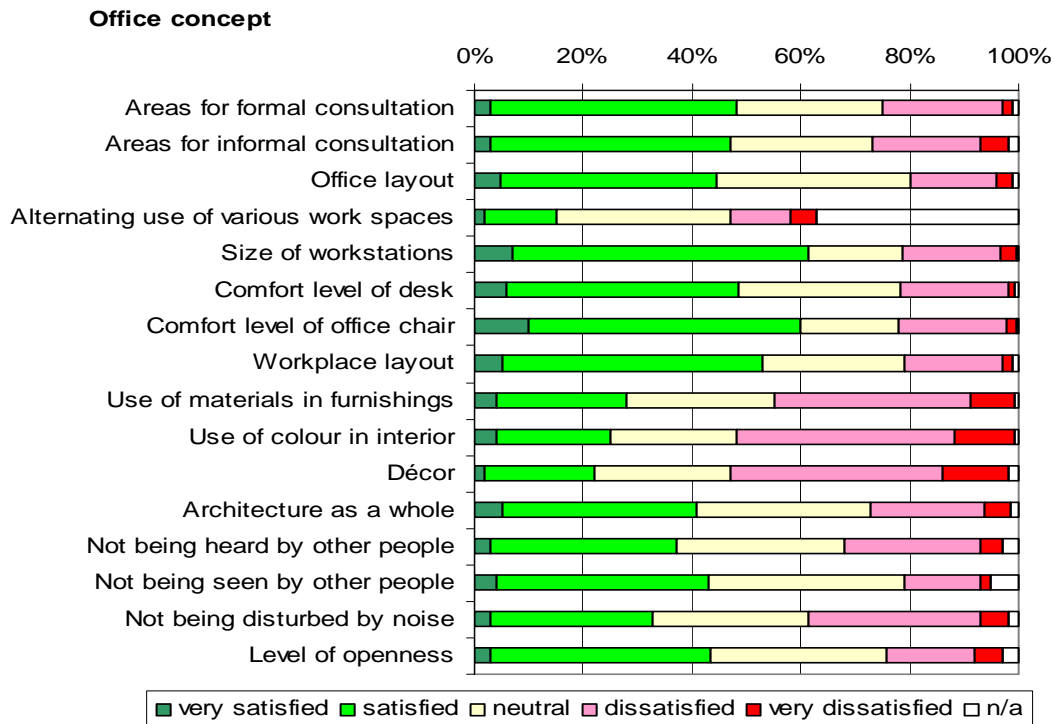


Figure 5 - Satisfaction and dissatisfaction about a number of issues

### Labour productivity

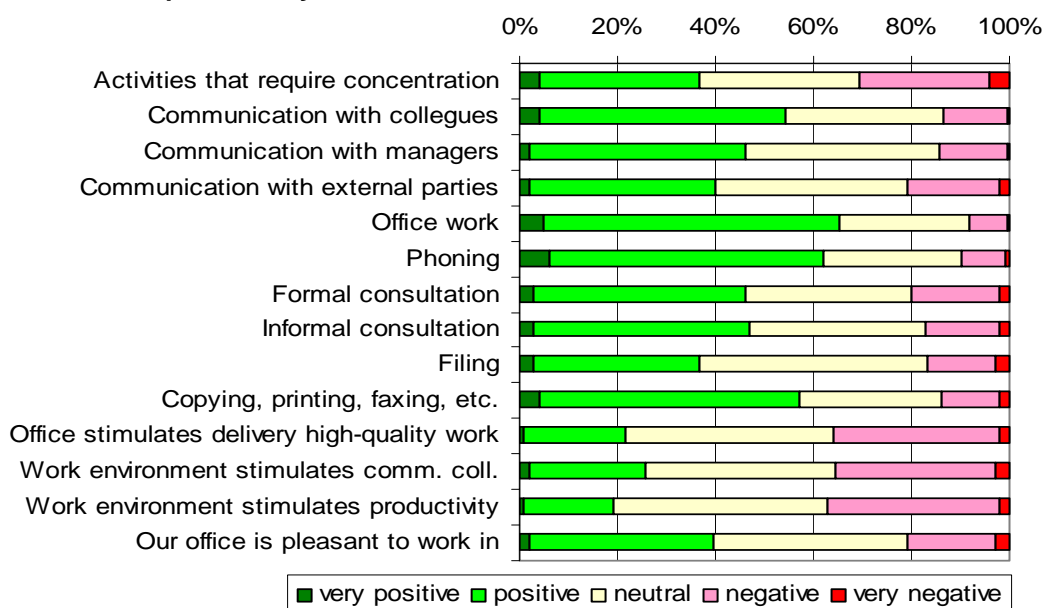


Figure 6 - Degree to which users believe the working environment stimulates the labour productivity of the stated office activities.

Variant 1			Variant 2
Digital filing	53%	47%	Printed documents
Open office with personal desks	43%	57%	2-person room with shared desks
Large storage space	11%	89%	Large work space
Spacious office with desk-sharing	34%	66%	Small 2-person room
Spacious office with desk-sharing	30%	70%	Narrow office with personal desks
Personal desk for all kind of activities	88%	13%	Desk-rotating along activity based workspaces
Environment supports communication	35%	65%	Environment supports concentration

Table 1 - Preferences of daily users of the building studied

There is little interest in desk rotation or desk-sharing, with 60% to 70% seeing little or no advantage in such a system. Two thirds of the respondents prefer to work in smaller two-person offices with a permanent desk rather than in a larger office with a system of desk rotation. A permanent desk for all activities is seen as preferable to different workstations for different activities. There is markedly more interest in centralised and digitised archiving, although approximately 25% of respondents do not view a central archive as an appropriate solution. Staff would rather have more space in which to work

than more space devoted to archiving facilities (Table 1).

Staff of the Main Building awards the implementation process an average score of 6.5. They consider it important to be given proper information. A minority wish to be directly involved in the planning process, with 23% expressing dissatisfaction with regard to the opportunities for contributing ideas.

The figures relating to the capacity utilisation reveal a particularly low occupancy in one department. On average, only 28% of all workstations are in use at any one time.

Occupancy is slightly higher in some areas of the department but never exceeds 40%. The interview rooms of the Human Resources department are used somewhat more intensively, with average occupancy of 55%.

### The influence of personal characteristics and the position held

There are no notable differences in appraisal between respondents of different genders. Women are slightly more inclined to disagree with the statement 'sharing workspaces is appropriate to the organisation', but at the same time the proportion of women who would prefer a spacious office with shared workspaces over a more cramped office with a personal workspace is slightly higher than among the male respondents. Interest in digital archiving facilities is slightly higher among the men.

Younger staff under 30 are most in favour of desk-sharing. They would prefer to occupy a two-person office. They regard a digital archive as a suitable solution to the organisation's requirements. This view is shared by the 31-40 age group, but they would prefer their own workspace in an open-plan office. Like the 40+ age group, when forced to choose the 31-40 year-olds would prefer a more spacious office with shared workspaces to a cramped office with a personal desk. Respondents aged between 30 and 50 attach great importance to having a working environment which stimulates communication. The younger members of this group wish to have a working environment which also helps concentration. Respondents over 50 show a clear preference (61%) for a paper archive, and are therefore set apart from their younger colleagues in this respect. Although the over-fifties would prefer to have a dedicated workspace, they would opt for a two-person office with shared desk rather than having their own desk in a large open-plan office.

All respondents with lower educational qualifications are opposed to desk rotation. The idea of shared workspaces meets with less opposition, although 55% would prefer a dedicated personal desk in an open-plan office to a shared workspace in a two-person office. This percentage is higher than in any other education category. This group is also most in favour of digital and centralised archiving. Staff with a secondary vocational diploma often expresses a preference for a more spacious office with shared workspaces above a small two-person office with personal desks. Similarly, this group expresses the strongest preference (42%) for a working environment which encourages communication rather than one

that promotes concentration. The group of respondents with higher vocational qualifications returns average scores on many points. Only with regard to having a dedicated workspace without sharing or rotation is there a marked preference, 84% preferring such an arrangement. This group believes that the working environment should primarily encourage concentration. A two-person office with shared workspaces is seen as preferable to an open-plan office with a dedicated workspace. The graduate respondents are least negative with regard to desk rotation.

In general, there are no marked differences between staff with a managerial or supervisory position and those without. Only in terms of communication and concentration can a difference be noted, whereby managers attach slightly more value to a working environment which encourages communication, and non-managers would prefer a setting which assists concentration. The managers also show an above-average preference for a digital archive. They would also rather occupy a shared workspace in a two-person office than a dedicated workspace in an open-plan office. It is interesting to note that 25% of the managers consider sharing workspaces appropriate to the organisation, while only 10% would actually wish to do so themselves. The seven senior managers who completed the questionnaire are all opposed to desk rotation or sharing, and also have a negative standpoint with regard to implementing any marked degree of openness and transparency.

The largest group of respondents is that of the policy staff. This group does not have a pronounced standpoint on any aspect. However, that of the junior policy support staff does, being the group most opposed to a digital archive and the only function category to express a preference (55%) for hard-copy documents and for an open-plan office with dedicated workspaces rather than two-person offices with shared workspaces (also 55%). This group also shows the highest percentage preference for dedicated workspaces in a working environment which assists concentration. The project managers group is the most positive with regard to desk rotation, regarding desk-sharing as an appropriate solution for the organisation. With 69% in favour, this is the only function group in which a majority of respondents believe that an open and transparent office is appropriate to the work processes. The group of administrative staff is least inclined to believe this. Moreover, 21% prefer more archiving space to more working space. Secretaries regard a digital archive as a good solution for the organisation, and their 82% preference for digital documents is the highest among all groups. The

proportion of secretaries who consider shared workspaces to be a good solution (38%) is also higher than that of any other function category.

### Implications of the research findings

The ministry's real estate policy's main objectives are to optimise the availability and costs of accommodation, while raising the satisfaction level of the users. Secondary objectives include achieving greater flexibility in workspace use, increasing the occupancy rate of workspaces, and reducing overall space by ten per cent. In the interests of staff satisfaction, it is recommended that visual privacy, ICT facilities, and reception and helpdesk services should be maintained at their existing high level. However, there are other aspects which now demand considerable attention in order to bring about improvements: meeting facilities, communication between staff, the degree of openness and transparency, the aesthetics and image of the building (colour, materials, architecture as a whole), cleaning and housekeeping, the ability to control the interior climate, and opportunities to work at home. It falls to the architect to address the requirement for greater openness and transparency, while maintaining the current level of satisfaction with regard to visual privacy. The current policy whereby the archives are being digitised is unlikely to meet with any great opposition. However, there is some conflict between the objective of 'achieving greater flexibility in workspace use' and that of 'increasing staff satisfaction'. The organisation's desire to reduce space usage calls for more flexible working arrangements, not least given the low occupancy rate of the current workspaces. However, the opposition expressed by many staff to flexible working arrangements suggests that it would be prudent to maintain the current cellular office arrangement with permanent workspaces. Should the Ministry nevertheless opt for a certain degree of flexible working for the sake of efficiency (the target 'flexfactor' of 9 workspaces per 10 employees has been cited), the reasons for such a decision should be carefully communicated to staff. Besides the low occupancy rate (which has been substantiated in that the exact research dates are given), the wish for greater flexibility in usage expressed by the staff should form an important consideration. A further consideration is that many part-time staff is not opposed to the idea of desk-sharing.

The research findings have recently been discussed at a workshop meeting with the ministry's real estate managers. Further to this meeting, principles for the renovation of the main building and for the

ministry's accommodation policy in general will be formulated.

### Research findings from other case studies

Apart from the case study discussed above, the Centre for People and Buildings has executed a number of other case studies into office buildings, both traditional cellular offices with personal desks and more innovative offices with desk-sharing and desk-rotating along a variety of workspaces for different tasks. These ongoing analyses offer a number of interesting lessons for commissioning clients, designers and building managers (VOORDT, et al, 2006):

- (a) Approximately half of all users surveyed believe that an innovative office concept is appropriate to their organisation. One in three has no opinion, while only one in five believes that an innovative office is *not* appropriate to their organisation;
- (b) In the three innovative projects studied, the percentage of positive responses is between 55% en 75%, while that in the traditional projects is between 43% and 57%. It would appear that personal experience of flexible working arrangements serves to make staff more positive;
- (c) Desk rotation enhances the dynamic of the organisation. Staff has more contact with colleagues, which encourages communication and the exchange of information and knowledge;
- (d) Approximately 40% of users are positive with regard to the degree of openness achieved. Approximately one third have no opinion in this regard;
- (e) Open office settings are appreciated by virtue of their spaciousness, the ability to see colleagues, and the opportunities for communication. However, they lead to dissatisfaction in terms of the lack of acoustic privacy and, to a lesser degree, visual privacy. Employees do not appreciate being heard and seen by everybody else;
- (f) Overall, the ability to concentrate is less appreciated than the ability to communicate. Approximately 30% of respondents are dissatisfied in this regard. There is a relatively high number of complaints about being distracted by noise;
- (g) In terms of concentration, traditional office concepts do not automatically score better or worse than the innovative alternatives. Even in offices with rooms shared by two or more persons, the ability to concentrate is not guaranteed. 'Cockpits' into which staff can withdraw should

they need to work in silence showed to be successful, provided they are available in sufficient number and are of sufficient quality in terms of climate control and acoustic properties;

(h) The support for innovative office concepts declines when the accommodation is too cramped. But where there are too many workspaces, users are unlikely to move from one to the other. This defeats the concept of workplace differentiation based on task differentiation, and will lead to the inefficient use of resources;

(i) The 'clean desk' approach does not give rise to many complaints. However, measures to ensure compliance must be in place;

(j) There is a reasonably high level of support for digital archiving among the current office staff;

(k) The desire to work at home is greater than current practice. This offers opportunities for further optimisation of workspace usage; and

(l) In general, more recently built buildings achieve higher satisfaction ratings for functionality ergonomics, aesthetics and image than their older counterparts. Users welcome good architecture, well-designed and ergonomically responsible office furniture, and high-quality IT facilities. If these aspects are addressed appropriately, this can serve to compensate for any failure to meet the preference for a permanent dedicated workspace, as expressed by a very large proportion of office users.

## Concluding remarks

This paper discussed a new integral tool for the diagnostic evaluation of non-territorial offices and the research findings from a number of case studies based on this tool. It shows that interesting lessons can be learned from post-occupancy evaluations, both in general and using this tool in evaluations of office buildings. Research findings from ex post evaluations can be used to improve the building that has been investigated, and also as an input into ex ante evaluation of other buildings, to build up a body of knowledge, to develop theories about "how buildings work" i.e. about experience, use and costs and benefits of different design solutions, and to develop design guidelines and recommendations for accommodation policy. Apart from product improvement, evaluations can also help to improve decision making processes and to support "evidence based" decisions. However, it is not suggested that findings from building performance evaluation, reference projects or design guidelines should be used to create a blueprint for the ideal building or building process. Any such blueprint would lead to

standardisation and uniformity, where as each design problem is more or less unique and very sensitive to its socio-cultural, physical, economical and juridical context. The optimal building lay-out and interior design are strongly affected by the location, the characteristics of the organisation, the personal preferences of the client, users and designer, and limiting conditions. Moreover every design has to strike a balance between partially conflicting desires and requirements. The result of this balancing process is highly variable, which means that there is no such thing as the 'ideal' building.

In work in progress the data from case studies are used in search of the possibility and desirability of developing a satisfaction standard (VOORDT; MAARLEVELD, 2006). In eight case studies the percentage of staff that are satisfied or dissatisfied with regard to several accommodation characteristics was identified (VOORDT *et al.*, 2006). An explanation of the deviation between percentages is also being sought, based on differences in actual building performance as established by empirical research. The bandwidth and average percentages can be used as an initial point of reference for other organizations. If the number of satisfied staff in a certain building is higher than the average for a series of buildings, then clearly the building in question scores higher than average in the perception of its users. It is also possible to 'raise the bar' and use the highest-scoring building as a benchmark. In answer to the Ministry of Agriculture's request, provisional norms have been established for a selection of 25 accommodation aspects studied, based on the average percentage of satisfied and dissatisfied staff in two buildings which enjoy a particularly high rating: an innovative office building used by the Dutch tax authorities, and the headquarters of the Ministry of Housing and Spatial Planning (Table 2). The selection itself is based on the results of desk research into the aspects which are dominant in determining user satisfaction, complemented by findings from a statistical analysis of the data derived from the cross-case analysis.

The present satisfaction index is being discussed now with a number of Dutch organisations and compared with data from new case studies.. It would be very interesting to compare results from Brazilian Post-Occupancy Evaluations of office buildings with this preliminary standard, both to discover in which country buildings perform better from a user's perspective, and also to learn whether user satisfaction is affected by the cultural and social-economic context.

Issues	Dissatisfaction (%)			Satisfaction (%)		
	Min	Max	Norm	Min	Max	Norm
Formal meeting places	3	57	20%	23	87	60%
Places for informal interaction	3	46	20%	23	93	60%
Office lay-out	7	19	20%	29	76	50%
Desk sharing	13	32	20%	15	59	50%
Openness and transparency	2	24	10%	34	67	50%
Communication with colleagues	4	14	10%	59	77	70%
Ditto with managers	7	22	10%	43	58	50%
Concentration	20	50	20%	24	58	50%
Not being heard by other people	20	58	30%	23	48	40%
Not being disturbed by sounds	28	60	30%	16	36	30%
Not being seen by other people	5	35	20%	29	40	30%
Use of materials	0	59	20%	12	86	50%
Use of colors	4	67	20%	12	80	40%
Use of art and greenery	10	70	30%	8	53	30%
Overall architectural design	4	71	20%	8	81	60%
Desk (size, comfort, adjustability)	2	41	20%	43	85	60%
Chairs (comfort, adjustability)	4	33	20%	46	88	60%
Filing	4	33	20%	21	48	30%
ICT	3	54	20%	21	78	50%
Reception	2	29	10%	38	71	70%
Helpdesk	9	31	20%	26	60	40%
Lunchroom	3	45	20%	31	77	70%
Cleaning	6	58	20%	22	67	50%
Climate (temperature, ventilation)	20	69	30%	20	60	30%
Personal control of climate	22	77	30%	10	54	40%
Opportunities to work at home	0	32	10%	21	77	50%

Note: Bandwidth of percentages of employees being satisfied and dissatisfied on a number of issues in eight office buildings and a proposal for a benchmark index with maximum percentages of employees that should be dissatisfied and minimum percentages of employees that should be satisfied.

Table 2 - First draft of a satisfaction index for office accommodation

## References

BAIRD, G.; GRAY, J.; ISAACS, N.; KERNOHAN, D.; McINDOE, J. **Building Evaluation Techniques**. New York, McGraw-Hill, 1996.

BECHTEL, R.; MARANS, R.; MICHELSON, E. **Methods in Environmental and Behavioral Research**. New York: Van Nostrand Reinhold, 1987.

BECKER, F. D.; JOROFF, M.L. **Reinventing the workplace**. Norcross, Ga., International Development Research Council. Report nr. 50, 1995.

BECKER, F.; SIMS, W. **Offices That Work**. International Workplace Studies Program, Cornell University, 2001.

BECKER, F. **Offices that work**. Uncommon workplace strategies that add value and improve performance. New York: Jossey-Bass (Wiley), 2004.

BOARDAS, B.; LEAMAN, A. Assessing building performance in use. **Building Research & Information** (29) no. 2, 2001.

DUFFY, F. **The Changing Workplace**. London: Phaidon Press Limited, 1992.

DUFFY, F., with POWELL, K. **The New Office**. London: Conran Octopus, 1996.

- MALLORY-HILL, S.; VOORDT, D.J.M. van der; DORTMONT, A. van. Evaluation of innovative workplace design in the Netherlands. In: PREISER, W.F.E.; VISCHER, J.C. (eds) **Assessing Building Performance**. New York: Elsevier, 2005.
- MAARLEVELD, M.; VOORDT, D.J.M. van der. **Renovatie en innovatie?** Delft: Centre for People and Buildings, 2006. [Renovation and innovation?]
- PREISER, W.F.E.; RABINOWITZ, H.Z.; WHITE, E.T. **Post-Occupancy Evaluation**. New York: Van Nostrand Reinhold Company, 1988.
- PREISER, W.F.E.; VISCHER, J.C. (eds) **Assessing Building Performance**. New York: Elsevier, 2005.
- VOLKER, L., VOORDT, D.J.M. van der, An integral tool for the diagnostic evaluation of non-territorial offices. In: MARTENS, B., KEUL, A.G. (eds), **Designing Social Innovation. Planning, Building, Evaluating**. Göttingen: Hogrefe, 2005a.
- VOLKER, L., VOORDT, D.J.M. van der, Werkomgevingsdiagnose-instrument. Methoden voor het meten van de prestaties van kantoorhuisvesting. Delft: Center for People and Buildings. {work environment diagnostic evaluation tool]
- VOORDT, D.J.M. van der; MEEL, J.J. van. Lessons from innovations. In DEWULF, G.; KRUMM, P.; JONGE, H. de (eds), **Successful Corporate Real Estate Strategies**. Nieuwegein: Arko Publishers, 51-64, 2000.
- PULLEN, W.R. **Evidence based reasoning**. A new challenge for Facility Management. Keynote SAFMA conference, Midrand Zuid Afrika, 2005.
- VOORDT, D.J.M. van der. **Costs and benefits of innovative workplace design**. Delft: Centre for People and Buildings, 2003.
- VOORDT, D.J.M. van der; MAARLEVELD, M.; ATTEMA, J. **Gebruikers over hun kantooromgeving**. Delft: Centre for People and Buildings, 2006. [Users on their office environment. Cross-case analysis of eight projects].
- VOORDT, D.J.M. van der; MAARLEVELD, M. **Op zoek naar een tevredenheidsnorm**. Delft: Centre for People and Buildings, 2006. [In search for a satisfaction standard].
- VOORDT, D.J.M. van der; WEGEN, H.B.R. van. **Architecture in use**. An introduction to the programming, design and evaluation of buildings. Oxford: Architectural Press, 2005.
- VOS, P.G.J.C. **Werkt het beter in Dynamisch kantoor Haarlem?** Faculteit Bouwkunde TU Delft, 1997–1999. [Does an innovative office fit better?]
- VOS, P.G.J.C.; VOORDT, D.J.M. van der. Tomorrow's offices through today's eyes, effects of office innovation in the working environment. **Journal of Corporate Real Estate** Vol. 4 No. 1, 48-65, 2002.
- VOS, P.G.J.C.; DEWULF, G.P.R.M. **Searching for data**. A method to evaluate the effects of working in an innovative office. Delft: Delftse Universitaire Pers, 1999.
- WORTHINGTON, J. (Ed). **Reinventing the Workplace**. New York: Architectural Press, 1997, 2005.
- ZEISEL, J. **Inquiry by design**. Tools for environment-behaviour research. Monterey, California: Brooks/Cole Publishing Company, 1981.
- ZIMRING, C. Post-Occupancy Evaluation and implicit theories of organisational decision-making. In: HOOGDALEM, H. van, et al (eds), **Looking back to the future**. Proceedings of IAPS 10, Delft University Press, 240-248, 1988.