

PACT: Calculating nWoW accommodation that suits the organisations' work processes

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Abstract:

Workplace change and New Ways of Working (NWoW) seem to have become a fixed value in FM practice in the Netherlands today. Stimulated by new technological possibilities and maybe even by the world-wide crisis, companies are rethinking their office environments. The possibility to work anytime and anywhere seems key. However this requires a different approach to quantify the needed space and determine the types of workplaces to fit an organisations' processes.

Since one employee is no longer automatically linked to one (specific) desk, and employees are expected to choose an appropriate workplace depending on the task at hand, the calculation of the needed floor space has become more complex. The expected attendance (presence in the office) needs to be quantified to give an indication of how much 'desk space' needs to be facilitated. However one also needs to take the activities that employees perform into account, to be able to specify different types of workplaces that can accommodate them. For this purpose a new calculation model was created. The PACT (Places and ACTivities) calculation model allows us to gain insight in the number and type of spaces needed, modulated by different scenarios and fitting to the organisation and its work processes. Additionally calculations can be limited to an existing framework (e.g.: the dimensions of the current building) as calculating a completely 'hypothetical' building often has little value. New variables in the model allow for calculations to be limited by dimension and time constraints.

Different scenarios help to discover which space requirements fit the ambitions and work processes of the organisation best. Through manipulation of different variables in PACT, valuable insight can be obtained into the number of work spaces (of specific types) needed. Moreover they allow us to consciously consider an 'allowed level of margin' while determining the dimensions of a work space (where the possibility of providing too many work places and the possibility of providing too little places is optimal).

Keywords:

Space calculation, simulation, workplace design, NWoW, flexible office use

Introduction

Nowadays 'New Ways of Working' (NWoW) is the popular term for what in literature is more commonly known as "social innovation". Social innovation is the development of new management skills, applying more flexible organizational principals, and realizing high quality forms of labour to increase the competitiveness and productivity of the company (Volberda, Jansen, Tempelaar, & Heij, 2011). Whereas NWoW is a rather recent term to describe a flexible approach to office layout and use, the idea is certainly not a new one. Van Meel (2011) states that "Concepts such as mobile work, desk sharing, video conferencing, the paperless office and open plan offices originate all from the 1970s or even earlier". However, whereas this 'new' way of looking at organizing work in an office used to be rather exceptional, now it is much more widespread. The changes in technological possibilities and the search for how to cut unnecessary expenses have resulted in many organizations reconsidering their office buildings. NWoW has therefore become more and more common in both office design in the Netherlands as in other countries around the world. NWoW most often includes characteristics like the freedom to decide when and where to work and possibilities for remote working. However, every company applies their own recipe of what is NWoW (Baane, Houtkamp, & Knotter, 2010).

NWoW is being implemented by organisations for several reasons. Often it is not only implemented to suit the needs and desires of the current employees, but also to accommodate the expected needs of future ones. Many companies believe that if they do not adapt, they will lose the 'war on talent', which is believed to become more apparent in the next few years. Furthermore Rieck and Kelter (2005) found that an attractive office improves the wellbeing of employees. Attention given to the choice in office design has an effect on employee satisfaction (De Been & Beijer, 2014).

Another imperative reason for implementing NWoW is the reduction of housing costs. By introducing NWoW companies can reduce the amount of square meters that are needed to house their employees. The overall average occupancy level in traditional offices, where workers have assigned work stations, is 46%. The average occupancy level of different workplaces ranges from 29% to 62% (Brunia, 2014). However, on average, at least one in every three workstations is not used. To reduce the amount of unused desks and the inefficient use of space, companies choose to change the work environment into an office with flexible use of workstations. In these more innovative offices with flexible use of workplaces (one does not have his own desk, but chooses a workplace that fits their activities at that moment best) the average occupancy level is almost 60% (range between 34% and 76% average). Peak occupancy levels vary from 55% to even 98%, which shows that the workplaces in these offices are on average used more intensively. The decrease of the amount of workplaces in a flexible work environment, and thus the amount of square meters, can strongly reduce the housing costs.

Cost reduction can not only be realized by reducing the needed square meters. Another optimization is the reduction of moving costs. Often, due to shifts in the work processes or outsourcing of activities, the size and needs of departments or business units can change. In the past, entire office floors needed to be renovated and teams and archives moved in order to accommodate a new department. However, companies nowadays are looking into the necessity of these renovations more carefully. More and more

companies desire work environments that can cope with organizational changes, such as the shrinkage or growth of a business unit. Having non assigned, standardized workplaces allows for internal changes without renovations in the office environment. These days the aim is that an office interior can stay unchanged for five to ten years.

Another benefit of allowing more flexibility in the choice of workplace is the possibility for employees to work from home (or other locations outside the office). This makes it possible to reduce the necessary office space even further. Moreover, it can shorten the time employees spend travelling and therefore also reduce travelling expenses (Baane et al., 2010). Thus it also reduces the time employees lose in rush hour traffic jams. By working at home, people are able to start their day sooner, without the need to travel to their office first.

Implementing NWoW is almost always combined with the introduction of activity based (non-territorial) working: employees can work anywhere and anytime and they choose the workplace which is best suited for the task at hand (e.g. an enclosed space when employees need to concentrate, a meeting space when employees need to discuss matters with their co-workers and an open workstation when they need to do administrative tasks). Activity based working usually implies that there are no assigned workstations. Rather, the desks are shared among a group of employees.

The reasons for implementing NWoW show that work environments or office buildings are more and more perceived as a strategic resource (Wernerfelt, 1984). Therefore the process of developing the optimal office layout for the activities and needs of a company becomes indispensable. It is not easy to find the balance between the amount of workspaces and the types of workspaces provided and the demand for different types of workplaces. If, for example, too many workspaces are created, the goal of cost reduction will not be achieved. On the other hand, if not enough space is provided, it might affect the productivity and wellbeing of the employees.

Whereas determining the size of the office space and number of places used to be based on the number of employees, the turn to NWO and activity-based office use has stimulated the search for a new way of calculation. Since no one employee is assigned to one desk any longer, it is no longer only the number of employees that determines the amount of desks. The office lay-out needs to suit the work processes and all the activities that employees perform while in the office. This requires (facility) managers to make the right choices about the mix of workspaces and places that will be made available.

The adaptation of NWO increases the number of determinants even more. NWO does not just mean an activity based use *at* the office, but also implies that employees are able to work anytime and anywhere. It gives employees the freedom of choice on where and when to work. The time that employees are not in the office also has an effect of the number of workspaces that need to be realized and it has an effect on the types of workspaces that must be provided. For example: it could be that all of the tasks that require concentration will be performed at home and that the office becomes a place to meet co-workers, schedule meetings and collaborate.

Creating a new office becomes a mathematical operation with numerous determinants to take into account. It has become more difficult for facility managers and board members to make the right decisions. Even more so, since the technological developments change rapidly, which in its turn has an effect on the possibilities to work from home. Calculating different possibilities by using a simulation model shows different possible solutions. The information that this simulation provides, could help managers to make the right choices.

The use of models that allow to calculate the necessary space and simulate future solutions has many advantages. According to (Augenbroe, 2002) using building simulation models allows for speeding up the development, increase efficiency, and enable the comparison between different design variants which lead to a more optimal design. There is a wide range of computer-aided building simulation programs available. They can be broadly divided into models that are concerned with computer-aided documentation, design and drafting and computer-based simulation (Hong, Chou, & Bong, 2000). However, when we look into the literature that has addressed building or office building calculation, it becomes clear that most articles tackle subjects such as the calculation of indoor climate or buildings costs.

More specific to the calculation of office dimensions, all the methods found seem to focus on one particular part of the question, thereby reducing the complexity of the issue. Fawcett (2009) for instance describes a model to calculate the optimum number of work places needed. This optimal capacity is determined by the 'supply and demand' of workplaces. Making the comparison with 'the newsvendor problem' from yield theory, he describes that there is an optimal number of workplaces; where the possibility (and therefore costs) of providing too many or providing too small places is equal. Fawcett also mentions that where the uncertainty of the demand increases, the optimal capacity will also increase. In other words, a larger margin of available workplaces is needed to accommodate bigger fluctuations in the demand for space. In another article he describes a simulation model that aims to find out whether the option of sharing places is suited for an organisation (Fawcett & Rigby, 2009). By using an agent based simulation model that takes different elements into account and simulates the demand for places in different 'runs', it uses probability to

visualise demand for workplaces at different times. The researchers state that what the model shows is an intimate connection between activity, space and cost variables. Simulating use can help an organisation explore the implications of shared working.

Another simulation model that tackles the optimisation of the use of workplaces is the model proposed by Kovacs, Emrich, and Wiegand (2013) that was developed in their 'more-space' study. The researchers use a computer model to simulate the employees' dynamic use of an office. By using computer simulation they are able to model human behaviour, compare alternatives and hypothetic scenario's and generate realistic results (Stefan, Wiegand, & Kovacs, 2011).

Looking further into other existing models that try to simulate use of office space and the corresponding space requirements, some are to be found in the commercial office real estate practice (e.g. ("HIPPCalculator," 2014; "Office Space Calculator," 2014). Since they are used commercially, by different consultancy firms, they (and their working) are kept non-transparent. Moreover, the models we found seem to suit only a 'traditional use' of workplaces (assigned desks). What does seem to be clear is that they often only partially describe the different determinants of the office layout calculation and that the calculation itself remains very much a 'black box'.

Even though these models are a valuable step in the search for how to determine the necessary workplaces, they leave out certain aspects which simplify reality. Because of the complexity of factors that have an impact on the spaces needed, the more elements we can capture in a simulation model, the more accurately we can calculate the results of future scenarios. Neither of the models described determines the number of workplaces by type, depending on the work process (or activities).

The PACT-model

In 2007 The Center for People and Buildings (CfPB)¹ developed a calculation model called Places and ACTivities (in short: PACT). This, because of the need for a calculation model that is able to simulate different scenarios for office space in a transparent manner while linking several determinants. At the time two different organisations (the Dutch Tax and Customs Administration (Belastingdienst) and the Rotterdam Municipality) were looking for ways to streamline the development of new workplaces, without losing track of the work processes and workers' needs. A research program was set up to develop a classification of 'job profiles' (or later: activity profiles) for all employees. This classification system would allow facility managers to quickly get a clear insight into the activities that needed to be facilitated in their new buildings. Subsequently the model was developed, adapted and tested while being used in different cases in for-profit and non-for-profit companies.

The PACT calculation model allows calculation of the needed office spaces (and related square meters) based on information of the places to be facilitated and the activities of the employees. It does this specifically by looking at activities; these form the link and the basis for the calculations. People perform different activities during their workday, and these activities need to be facilitated by the workplaces that are provided. Each workplace is better or less suited for certain activities.

PACT was developed to provide input for the development of office use concepts within buildings. Although it is possible to calculate different uses of workplaces, which includes assigned workplaces (every employee has their own workstation) the models' initial starting point is to reason from a flexible (activity based) use of workplaces.

PACT focuses specifically on the *work* spaces of the office building. Although it is possible to add other specific spaces and facilities (like a company restaurant) into the model, its true strength lies in the calculation of workplaces and meeting rooms. In a more detailed view, the end results of the PACT model provide a view of the number of workstations, meeting rooms and facilities needed (including the square meters necessary).

The calculation can provide valuable information during the development of new (office) work environments. It can provide data as input for the *Schedule of requirements*. But above all it can quickly calculate the outcomes of different scenarios, which allows companies to test different inputs and organizational decisions and their impact in the future. This makes it possible to visualise the implications of organizational decisions. In this way it is also possible to test the margins of the calculated result, and to which extend the future building will be able to cope with different future situations like growth or shifts in activities within the company. It is also possible to calculate one or more locations of an organisation. Portfolio-analyses show different opportunities on which organisations can build their real estate strategy.

¹ The Center for People and Buildings (CfPB) is an independent not for profit, scientific knowledge center that undertakes research into the relations that exist between people, work and workplace environments.

The main determinants in PACT

The model contains a large number of variables that can alter the calculated results to simulate different contexts. The two most important elements are the activities of employees and the places that can accommodate these activities. As mentioned before the activities form the essential link between people and places.

The calculation by the model is also determined by the choice of the space occupation option. Six options are possible. They describe the base for the calculation of the number of workplaces, meeting spaces and support spaces. On the one hand a choice can be made for a traditionally used space. Herein each FTE is accorded a desk and no subtractions are made for absence from the office. In other words: a workplace is available for each employee, 100% of the time. In more restricted and flexible options, sharing desks and subtracting absence from the office (home working, sickness or holidays) can reduce the amount of calculated workplaces.

Activities

To determine what spaces and workplaces are needed, the starting point should always be the work processes of the employees and the activities they perform. Therefore an essential part in calculating offices suited for NWoW is the use of activities. To operationalize this element in the model, activity profiles were developed (Beijer, 2011). Activity profiles describe the pattern (percentages) in weekly activities of the different 'types' of employees in the organisation. The activities that are described in the profiles are chosen because of their relation to workplaces and differentiation in places used because of activities. These profiles classify employees in groups with comparable activity patterns. Each profile represents part of the employee population.

Places

The second major element in the calculation are the workplaces. After a choice is made by the management which workplaces and meeting rooms they want to implement, the number that are needed of each can be calculated by the model. It is possible to calculate a large number of places with minor differences, but this should always be in relation to the organizational needs and the number of FTE (full time equivalents) to be housed in the building². When choosing the places, one should consider the differentiation and needs. Each workplace type is specified in the model by its different attributes:

- Category (workplace, meeting place, facilities and other places)
- Name and description (e.g. 1-person silence workplace)
- Number of square meters required
- Number of employees the place is meant for (e.g. meeting rooms are suitable for more than one person)
- Number of workplaces per workspace
- If the place suites 'activity related use' or if the place is suited as an assigned workstation

A very important 'attribute' in the description of the workplaces is the suitability of the place for different activities. These activities match with those in the activity profiles of the employees. It is through this suitability that the link is made between the activity profiles to be facilitated and the spaces that are needed. Of each place described in the PACT model an estimation has been made to which degree it is suited to a certain activity. For instance, a place can be very well suited, partly suited or not suited at all for work that requires concentration. Some facilities (or: support spaces), however, are not calculated based on their suitability for activities. These facilities (such as a coffee corner, a printer area or a canteen) are determined only by the number needed per FTE. (For instance: the number of canteens is not determined by the activity 'eating' but by the number of canteens needed to accommodate the total FTE. It could be said that a separation is made between the 'activity related' and 'non-activity related' places in the model, and consequently on their method of calculation.

Other determinants

As mentioned the base for the PACT calculations is relating activities that employees perform to the places that can accommodate them. The calculation is however also determined by several other determinants:

- Number of FTE and the job descriptions
- Ratio of employees per FTE
- Employee group information: units, departments, ...
- Part-time ratio
- Average absence percentage due to holidays and sick leave
- Percentage of time employees work at home

² To illustrate the influence of the organizational needs, one could give the example of a specialized department needing very specific workplaces: extra large tables to display maps or a double computer screen. The second consideration in this respect is the number of FTE. to be housed. If the number of FTE. is small, one should be careful not to choose too many places. Every place that is chosen in the model, will be calculated. With a small amount of FTE. this will result in an over estimation of the places needed. To give an example: if you would want to facilitate a group of 2 employees with a 8 person meeting room, one of such places will be calculated for 8 people, resulting in an over calculation of 6 places

- Possible growth/ shrinkage of the company

Calculating Scenarios

All above mentioned elements help to model the results and calculate different future scenarios. These future changes could take place because of choices the management makes or because of external factors like the world-wide financial crisis. By changing certain elements in the model different 'futures' can be calculated. This information can support the management's decision process with respect to the office layout and its use. One example might be the an increase or decrease in the number of employees: calculation of these changes can for instance show that if the organisation grows, they might not fit in their current office building.

Another choice for the management to consider the balance between differentiation and uniformity. In an office which has a standardised layout and look, it is easier to move employees from one floor to another without disturbing the work processes. If however, the lay-out varies strongly, it might be that after a move the work processes of some departments are not optimally supported by the work environment anymore. The work environment designed for one departments work processes might not fit the activities of another department quite so well. Standardisation, however also has its drawbacks. One size certainly not always fits all. Work processes and employee needs might vary strongly between departments. Additionally, the employees might feel that their specific needs are not considered enough in such an environment. Management needs to compare the activities of the different business units and decide if it is possible to develop a work environment which is universally enough to cope with changes within the company, but does still supports the work processes of a specific business unit. It is a search for the right balance, in which the comparison of different PACT scenario calculations comes in hand.

Another interesting change that might be calculated is the move to more home and remote working. When NWoW also includes working from home and other locations, the effect can be made visible. What are the spatial consequences of obligating all employees to work at home one day a week, for instance. Management can decide if they allow working from home with certain restrictions or if they let employees decide which percentage of the time is spent in the office. Calculations can compare what the effects are of these choices and can compare the necessary workspaces of each choice. PACT allows for different ways to consider home working, and it recognises that some activities are possible at home (concentrated desk work) while others might not be (meetings with more than 16 people).

Combining these future changes is even more interesting. Each element in PACT is one that can be altered to show different results and make the outcomes of different scenarios clear. For example: could an organization still fit in their current building when the number of employees increases, but when working from home is allowed? Calculating several scenarios can help the management decide on these matters. By showing the changes in necessary spaces, square meters and also making the consequences of different ways of working clear, based on which the management decide on their strategy.

Reasoning

Despite the most obvious fact that the PACT model provides calculations and numbers of spaces, it was not solely designed for calculation. Because of the wide range of elements that can be changed, an almost infinite number of calculations are possible. However, calculation every possibility is less interesting, it is the choices that are made and the reasoning behind them that are key. By gathering the information that is needed in the model, companies are forced to think about the choices that they are to make. PACT asks those involved to organize their thoughts and policies on different topics. The management needs to develop a view of the wanted and prospected way of working, the working process and the relations with this working process. This also needs to result in a clear view of not only the future of the organization, but also of the organization's building policies and goals. And, as mentioned by many in literature and practice: the implementation and how the choices are translated to 'reality' are essential.

The management is often not aware of all the possibilities in office design. It happens they do not realize enough the consequences of creating a non-territorial office. Using PACT in a research setting encourages management to discuss the consequences of choices. What is the effect of a specific choice and what consequences are there for management, employees and work process? When employees are used to having their own desk, moving to a non-territorial office requires very different patterns of behaviour and knowledge about the appropriate use of spaces. When using the model, it is therefore important to not only come up with the data they need, but also to help management in making the right decision based on all facts available. It is also possible to do a portfolio analysis, which can help organisations to decide whether to concentrate work at certain locations or reduce the number of locations because.

Although every organisation wants to be as efficient as possible, effective office space does not mean having a workplace where every workstation is occupied all the time. When employees can only work at a certain workstation and do not have a choice to sit where they desire or which is required for performing the task at hand, satisfaction rates can drop. Employees will feel like the office is too crowded and may even avoid being at the office by working only from home. Management needs to be aware of this issue and

make a decision which occupation rate (number of workplaces to employees or FTE) they feel is still acceptable, without putting too much pressure on the work environment. Employees also have a feeling of crowdedness when certain workspaces are always occupied. This limits their choices to work there once (e.g. in some organizations single rooms are always occupied because employees feel like they are the least distracted). Managers need to be aware of these issues and if necessary take measurements to release pressure on these workspaces by informing employees about the purpose of the workstations or by putting restrictions on the use of these spaces (e.g. being able to work there for a maximum of two hours).

The PACT model is an expert model that is complex and is comprised of many elements. Therefore it is not possible at the moment for an organisation to use it without assistance of the CfPB. In all the studies where PACT was used, different sessions with (facility) managers were organised. PACT is applied in a collaborative process between the researchers and the organisation. During this process information is gathered, put in the model and calculations are made. In the different sessions attention is also given to the reasoning behind the decisions that are made and the input that is used.

Discussion: Future adaptations to the model

Because of the questions asked the model never stops developing. To be able to calculate the most realistic scenarios for the future we have to try and capture all the elements that might have an influence on the end result. There are a couple of determinants that might be included in the model in the future. One of them relates to the fact that some areas in the work environment are not used as effectively as could be. Whereas the model calculates an ideal and optimally effective use, reality might be quite different. Meeting spaces for example are rarely used before ten in the morning and they are also rarely used after four o'clock in the afternoon. At the moment however the model spreads the use of spaces evenly over time. On the other hand organisations might wish to use their environment as efficiently as possible and spread the times when meetings are scheduled.

Another addition to the model also concerns 'time'. Introducing NWoW means that employees have the freedom to choose when they work. No longer do people only work from nine to five; employees decide which hours suit them best. This means that the openings hours of offices are put into question. Extending openings hours might be an option. By adding the option to calculate the effect of longer opening hours, managers can decide if this is beneficiary to the productivity and the effectiveness of the organisation.

Also to be further developed in the model is the addition of different types of users. Many organisations do not only house employees, they also receive visitors, external workers or students in their buildings. Some spaces are not only used by employees, but also by these groups. To take these groups and the activities they come to the building for into account, we will need to incorporate new determinants in PACT, so their needs can also be calculated in the necessary space.

One more useful addition to the PACT model might be the possibility to prioritize places. At this moment, when a place is suited for a certain activity, it will be calculated. However, it could be that an organisation decides that a group of employees needs to work in a certain workspace (e.g. every department needs one team room or every manager should have their own assigned workplace). By prioritizing the workplaces needed, the model would calculate more of the preferred places.

We found that PACT can not only be used for calculating the needed office environment but also to discuss real estate portfolio for a big organisation with different locations like universities, government organisations with several offices around the country or multinationals. Portfolio analysis might also ask for new adaptations which we have to research e.g. travel time or distance, shared facilities and services, combined work processes and space that is needed for flexible work from colleagues of other locations not related to the number of employees.

Conclusion

Now that workplace change and NWoW have become more important in portfolio management, organisations have the opportunity to re-think their way of facilitating the work process. Working anytime and anywhere requires a different approach to quantify needed space that fit the organisations process. PACT-model can help to discover the consequences of office real estate choices, related to activity patterns, differentiation of workplace use, workplace types and occupation in offices. Additional elements like the dimensions of the current building, expected future developments and time constraints can help to discover which workplace environment fits the organisation best, now and in the future.

The PACT model is designed to calculate the number of workspaces necessary and to reason which scenario would suit the organisation best. It may not be meant to directly design the environment, but organisations can use the results to communicate with architects or interior designers.

The PACT model is a useful tool for organisations during the decision making process. By transparently calculating different scenarios, the implications of different layout choices are made visible. By changing elements in the calculation an organisation can

for example explore what it would mean for the office space needed if the employees to work one day from home a week, if the work process shifted more to communication activities, or if the organisation grew. Some of the main issues put forward by using PACT are:

- How can the workplace environment contribute to the organisation goals?
- How much can the organisation reduce necessary square metres by switching from assigned to flexible or activity based workplaces?
- What is the difference between flexible and activity based workplaces?
- Does NWoW ask for different types of workplaces and space?
- How can work process in NWoW best be supported? and
- What does it mean for management, employees and work process?

Using PACT to develop real estate portfolio scenarios has been explored but needs to be further developed in collaboration with real estate organisations. Since we are able to show in the calculated results how buildings fit to activity patterns and flexible use, real estate organisations can discover how they can use this kind of information. This way they can make buildings as attractive as possible for organisations by really adapting to the organisations' needs.

The model is quite complex since it considers a broad range of elements, but can be used in collaboration with the researchers. In this process several exchanges are organised between researchers and the organisation, in which input data is collected and discussed. This iterative way of applying the model emphasises it is not only aimed at calculating but also at reasoning space.

References

- Augenbroe, G. (2002). Trends in Building Simulation. *Building and Environment*, 37, 891-902.
- Baane, R., Houtkamp, P., & Knotter, M. (2010). *Het nieuwe werken ontrafeld, over bricks, bytes & behaviour*. Koninklijke Van Gorcum b.v.
- Beijer, M. (2011). Activity wizard - Kennis over activiteitenpatronen van medewerkers. Delft: Center for People and Buildings.
- Brunia, S. (2014). Het gebruik gemeten. Bezettingsgraden in kantorenland. Proceedings van het Center for People and Buildings. . Delft.
- De Been, I., & Beijer, M. (2014). The influence of office type on satisfaction and perceived productivity support. *Journal of Facilities Management*, 12(2), 142 - 157.
- Fawcett, W. H. (2009). Optimum capacity of shared accomodation: yield management analysis. *Facilities*, 27(9/10), 339-356.
- Fawcett, W. H., & Rigby, D. (2009). The interaction of activity, space and cost variables in office workstation sharing *Journal of Corporate Real Estate*, 11(1), 38-51.
- HIPPcalculator. (2014). from <http://hippconsultancy.nl/index.php?id=3>
- Hong, T., Chou, S. K., & Bong, T. Y. (2000). Building simulation: an overview of developments and information sources. *Building and Environment*, 35, 247-361.
- Kovacs, A., Emrich, S., & Wiegand, D. (2013). *Strategies and Methods to improve Spatial Management within Companies*. Paper presented at the EFMC, Prague.
- Office Space Calculator. (2014). from <http://www.tenantadvisors.com/calculator/>
- Rieck, A., & Kelter, J. (2005). *The empirical OFFICE 21® study "Soft Success Factors"*. Paper presented at the HCI International.
- Stefan, E., Wiegand, D., & Kovacs, A. (2011). *A Mathematical Simulation Tool for Increased Space Utilization Efficiency*. Paper presented at the International Journal of Facilities Management, Prague.
- van Meel, J. (2011). The origins of new ways of working: Office concepts in the 1970s. *Facilities*, 29(9/10), 357 - 367.
- Volberda, H., Jansen, J., Tempelaar, M., & Heij, K. (2011). Monitoren van sociale innovatie: slimmer werken, dynamisch managen en flexibel organiseren. *Tijdschrift voor HRM*.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171-180. doi: 10.1002/smj.4250050207