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DESIGNING FOR HEALTH AND WELLBEING: VARIOUS CONCEPTS, SIMILAR GOALS

PROJETANDO PARA A SAÚDE E O BEM-ESTAR: VÁRIOS CONCEITOS, METAS SIMILARES

Theo van der Voordt¹

ABSTRACT:

The last decades show a growing interest in the impact of buildings, facilities and services on health and wellbeing. This paper aims to present different design concepts that have been developed to support health and wellbeing of the end users, such as healing environments and healthy offices, or to avoid negative impacts, such as the Sick Building Syndrome and toxic workplaces. Each concept is supported by a selection of references to available evidence of its influence. The paper is based on an extensive narrative literature review of buildings and facilities related publications on how to provide healthy environments, with a focus on offices and health care facilities. The discussed design concepts have much in common, but also different focus points. Overall it is shown that a variety of building design characteristics - spatial layout, indoor climate, interior design, finishing, contact with nature - affect the health and wellbeing of building users. Facilities such as desk bikes and plants and services such as healthy food and drinks or healthy behaviour stimulating programs have a positive impact as well. As a consequence, the design and management of healthy environments needs a multidisciplinary approach and collaboration between designers, corporate real estate and facility managers, human resource managers, IT specialists, and the involvement of different stakeholder such as clients and end users.

KEYWORDS: healthy workplaces; building syndrome; user wellbeing

RESUMO:

Nas últimas décadas tem sido demonstrado um interesse crescente no impacto de edifícios, instalações e serviços na saúde e no bem-estar de seus usuários. Este artigo tem como objetivo apresentar diferentes conceitos de projeto desenvolvidos para apoiar a saúde e o bem-estar dos usuários finais, como ambientes de recuperação e escritórios saudáveis, ou ainda para evitar impactos negativos, como a Síndrome do Edifício Doente e ambientes insalubres de trabalho. Cada conceito é apoiado por um conjunto de referências relativamente às evidências disponíveis de sua influência. Os conceitos de projeto discutidos no artigo têm pontos de convergência, mas também diferentes focos. No geral, é mostrado que uma variedade de características de projetos para a construção – layout espacial, clima interno, design de interiores, acabamentos, interação com a natureza entre outras, afetam a saúde e o bem-estar dos usuários do edifício. O artigo também destaca que facilidades como bicicletas fixas, vegetação, serviços como alimentos e bebidas saudáveis e programas de estímulo ao comportamento saudável, também têm um impacto positivo. Como consequência, o projeto e a gestão de ambientes saudáveis precisam de uma abordagem multidisciplinar e da colaboração entre projetistas, imobiliárias corporativas, gestores de facilidades, gestores de recursos humanos, especialistas em TI e o envolvimento de outros diferentes agentes interessados, como clientes e os próprios usuários finais. **PALAVRAS-CHAVE:** ambientes saudáveis de trabalho; síndrome do edifício doente; bem estar do usuário.

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INTRODUCTION

The World Health Organization (WHO) defines health as a state of complete physical, mental and social wellbeing. This incorporates a wider scope than just the absence of disease or infirmity. Nowadays, a growing interest in health and well-being comes to the fore, which is visible in the wide use of sport facilities, personal training programs, anti-smoking programs and other health promoting programs, organized by governments, public and private organisations, and individuals such as members of a participation council. This trend may be due to the growing awareness that health is a key factor in people's quality of life. Another factor might be the worries about the high number of people who drop out from the labour process, due to a burnout, resulting in unwanted personal circumstances, absence due to sick leave, and high health care costs.

IMPACT OF THE BUILT ENVIRONMENT

In addition to the general interest in health and wellbeing, the impact of buildings gets more attention as well. This is reflected in an increasing number of publications on healthy workplaces, health care facilities, schools, and neighbourhoods. This trend might be due to the shift among clients from a primary focus on cost reduction to an increased awareness of the added value of buildings, facilities and services for customers, end users, the organization, and society as a whole (Jensen, Van der Voordt & Coenen, 2012; Jensen & Van der Voordt, 2017). Currently added value and value adding management have become common issues in decision-making processes in practice and in academic research. One of the possible added values of appropriate buildings, facilities and services is their contribution to employees' health and well-being.

The introduction of the WELL Building Standard™ in 2015 by The International WELL Building Institute is another example of the growing interest in the relationship between the built environment and health and wellbeing (see <https://www.wellcertified.com/about-iwbi/>). The standard sets benchmark measures required to achieve accreditation as a healthy work environment and covers seven aspects: air, water, nourishment, light, fitness, comfort, and mind. Other tools that link the built environment to health and wellbeing are FitWell (Center for Active Design, 2019), Healthy Active by Design (Heart Foundation, 2018), and the Happy Building Index from the Dutch Stichting Happy Building Index (www.happybuildingindex.nl).

PURPOSE AND OUTLINE OF THIS PAPER

The current paper aims to discuss various design concepts that have been developed to provide healthy environments, available evidence about its impact, and which lessons can be learned from the different approaches. The next section presents a conceptual framework of influencing factors on health and wellbeing and possible interrelationships between health and wellbeing and other values. Section 3 presents the methodology. Section 4 discusses the findings i.e. design concepts that aim to promote and support health and wellbeing of the end users. The paper ends with section 5: reflections and conclusions.

CONCEPTUAL FRAMEWORK OF INFLUENCING FACTORS

Apart from the built environment, many other factors have an impact on people's health and wellbeing, probably even more than design factors (Jensen & Van der Voordt, 2020), such as:

- contextual characteristics (living circumstances at home, social contacts, governmental and local policies, culture, economics);
- personal characteristics and behaviour (age, gender, education, knowledge and skills, personality, physical shape, intrinsic motivation, life style);
- organizational characteristics (leadership style, organizational structure, staff and other colleagues, social cohesion, trust, level of competitiveness, atmosphere, future perspective);
- job characteristics (work patterns, job demands, supportive resources, personal control, time pressure, stress, feelings about one’s job).

Figure 1 shows a conceptual model that visualizes the assumed influence of the physical environment on health and wellbeing and other values such as employee satisfaction, productivity and costs (arrow a), possible impacts of other factors on health and wellbeing and other values (arrow b), interrelationships between health and wellbeing (arrows 1- 2), and the possible added value of health and wellbeing and other value parameters for individuals, the organization, and society as a whole (arrows c1 and c2) (adapted from Van der Voordt & Jensen, 2020). The current paper focuses on the coloured blocks of the model in Figure 1, as part of arrow a. Other relationships are beyond the scope of this paper.

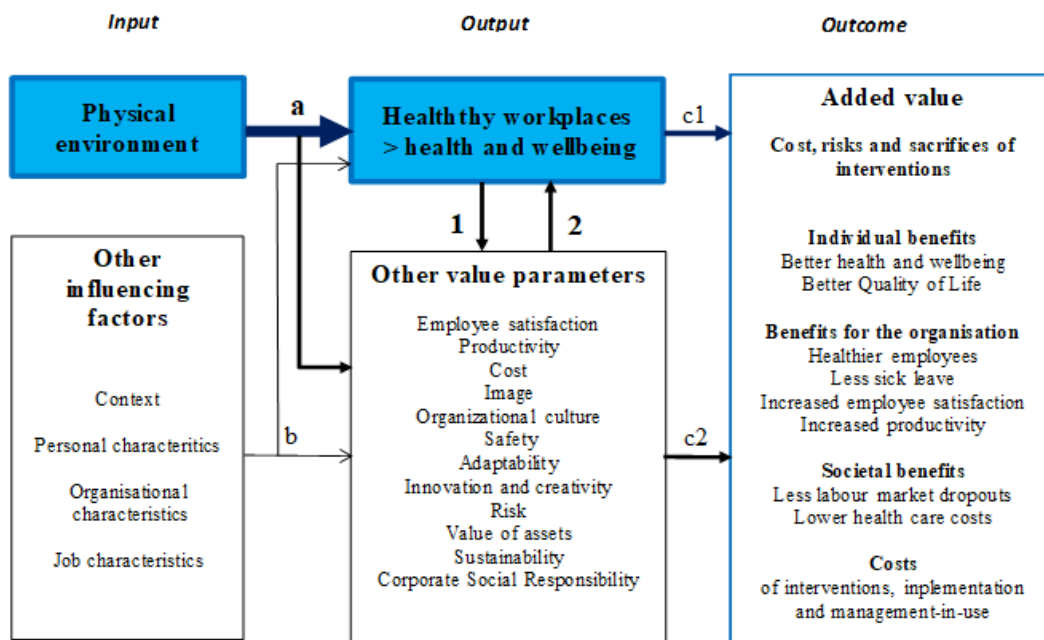


Figure 1. Conceptual model of possible relationships between physical characteristics of the work environment, health and wellbeing, and other values (Van der Voordt & Jensen, 2020)
Source:
 The Author

The original model mentions only healthy workplaces in the first block of the second column. This term has been replaced by healthy workplace > health and wellbeing, because health and wellbeing is the key topic of this paper and because the second column includes all (added) values that were distinguished by Jensen and Van der Voordt (2017). The distinction between output and outcome is in line with the Value Adding Management model by Hoendervanger et al. (2017) that makes a distinction between positive impacts and contributions to organizational objectives.

METHODOLOGY

This paper is part of an ongoing literature review on healthy workplaces by the current author and Per Anker Jensen, professor in Facilities Management at the Technical University of Denmark. This review applies a structured approach according to Webster and Watson (2002). In a first paper about impact factors on healthy workplaces (Jensen & Van der Voordt, 2020), four Facilities Management (FM) and Corporate Real Estate Management (CREM) oriented journals were checked for relevant papers in a ten-year period, covering 2008-2017: Journal of Corporate Real Estate (JCRE), Corporate Real Estate Journal (CREJ), Facilities, and the Journal of Facilities Management (JFM). In addition, the Workplace Health & Safety Journal and the International Journal of Workplace Health Management have been screened. However, most papers in both latter journals focus on organizational interventions such as fitness programs, healthy food, weight management, hygiene, pet-friendly workplaces, burnout prevention, health code of conduct, and prevention of bullying and violence.

This first literature search has been extended to the period 2018-2020 and to other journals, in order to explore the added value of healthy workplaces (Van der Voordt & Jensen, 2020). In particular, the last five volumes have been screened of *Applied Ergonomics*, *Building and Environment*, *Building Research & Information*, *Environment and Behavior*, *Ergonomics*, *Intelligent Buildings International*, and *the Journal of Environmental Psychology*. A journal with the promising title Performance Enhancement & Health, showed to focus on sport, performing arts, drugs, and doping, and to neglect the impact of the built environment, so this journal was left out. For the current paper, additional references were assessed to get a better understanding of the design concepts that will be discussed below.

DESIGN CONCEPTS TO SUPPORT AND PROMOTE HEALTH AND WELLBEING AND TO AVOID DISEASES

This section discusses the following concepts:

1. Healing environments / healing architecture
2. Health promotive building design
3. Salutogenic design
4. Biophilic design
5. Healthy workplaces
6. Healthy offices / healing offices
7. Sick Building Syndrome / toxic environments

HEALING ENVIRONMENTS / HEALING ARCHITECTURE

The concept of a healing environment is strongly connected to health care settings. The assumption is that appropriately designed buildings can facilitate people's health and wellbeing. This concept is often related to Evidence-Based Design (EBD) (Ulrich et al., 2008; Hamilton & Watkins, 2009; Ulrich et al., 2010). In line with medical interventions, evidence-based design refers to "the conscientious, explicit and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about

the design of each individual and unique project” (Hamilton, 2007). One of the first papers on healing health care environments is the one by Ulrich (1984). He found that patients with a view on nature suffered fewer complications, used less pain medication and were discharged sooner than those who looked out on a brick wall. His study led to renewed attention to the role of the built environment in health-related outcomes in healthcare settings. This insight actually goes back to the nurse Florence Nightingale, who already in the nineteenth century paid attention to the positive impact of contact with nature, fresh air and clean water.

Studies on healing environments in the health care sector have been carried out by researchers in various disciplines such as architecture, construction management, nursing, medicine, environmental psychology and public health. See for instance Tanja-Dijkstra et al., 2006; Ulrich et al., 2008; Ulrich et al., 2010; Beukeboom, Langeveld & Tanja-Dijkstra, 2012; Huisman et al., 2012; Shepley et al., (2012); Laursen, Danielsen, & Rosenberg (2014); Nejati et al. 2016; and Bosch & Lorusso, 2019. These studies show that the building layout, percentage of single bedrooms, indoor air quality, daylight, acoustics, interior and finishing (e.g. colours and materials) and outside view of hospital buildings and other health care facilities can lower the incidence of infections, patients’ intake of pain medication, medical errors, patient falls and staff injuries, reduce stress, improve safety and productivity, enhance wayfinding, and support sustainability. For some interesting architectural examples of healing environments see e.g. Bensalem (no year).

The research on healthcare building design and health-related outcomes has resulted in several changes in healthcare building design. New hospital wards are increasingly planned with single-patient rooms to reduce the spread of infection (Steinberg et al., 2013), to increase dignity (Baillie, 2009) and to allow a more flexible visitor schedule (Bosch & Lorusso, 2019; Huynh, Owens, & Davidson, 2020).

Based upon this growing body of knowledge, healthcare architects have begun to brand healthcare buildings as ‘healing architecture’ (e.g. Nickl-Weller and Nickl, 2013) or ‘health-promotive architecture’ (section 3.2), and to cite related concepts such as ‘salutogenic design’ (section 3.3) and biophilic design (section 3.4).

HEALTH-PROMOTIVE BUILDING DESIGN (HPBD)

The concept of Health Promotive Building Design (HPBD) is also strongly connected to health care settings. The World Health Organization (WHO, 1986; 2021) defines health promotion as ‘the process of enabling people to increase control over and to improve their health’. Green et al. (1999) defined six health promotion criteria: encouraging public participation by individuals and communities; taking a socio-cultural perspective; emphasizing equity and social justice; fostering intersectional collaboration between health care organisations; taking a holistic view of health; and focusing on enhancing health (salutogenics) and not simply preventing problems (pathogenics). As such, health promotive health care organizations expand their traditional focus on the treatment of disease to the health development of their patients, their staff, the local population and the environment (Johansson et al., 2009; Johnson, 1999).

Environmental features of HPBD includes in particular (Pelikan, Krajic, & Dietscher, 2001; Harris et al., 2002):

- ambient aspects such as acoustics, light and climate
- architectural aspects: building structure, spatial layout, availability of appropriate spaces for different activities and user groups regarding size, shape and location, distances, and the placement of openings (windows, doors);

- interior design: furniture, IT, art, plants, signage;
- social aspects e.g. territoriality, culture, social interaction, privacy and contextuality;
- maintenance aspects such as the need for clean and tidy environments and artwork that is easy to maintain.

The assumption behind HPBD is that appropriate design of health care facilities can actively support treatment, protect health, and prevent disease for diverse building users and the local population (Miedema et al, 2019; Miedema, 2020).

In one of the cases described by Miedema (2020), HPBD is interpreted to accommodate specific health-promotive activities, support health-promotive processes, symbolize health promotion visions, and empower people through the design process. Accommodating health-promotive activities regard the availability of health-promotive programs such as educational kitchens, fitness facilities, health libraries, lecture spaces, interpreters' offices and spiritual spaces. Examples of support of health-promotive processes are the adaptability of departments, the possible expansion of the building to adjust to changing health demographics, and a floorplan that allows provides easy access between divisions and thus supports cross-division collaboration among staff members. An example of the symbolic role of healthcare building design to reflect the health-promotive vision can be found in the design of Angered's Narsjukhus in Sweden. This facility has been designed as one building with one entrance and one reception area to symbolize the intensive collaboration between primary and specialized care.

Apart from the design as a product, the design process is important as well. Miedema (2020) identified four important strategies in health-promotive building design: implementing research, involving diverse stakeholders with diverse knowledge (e.g. clients and end users), developing supportive documentation, and considering the environmental impact.

SALUTOGENIC DESIGN

The word "salutogenesis" comes from the Latin *salus* = health and the Greek *genesis* = origin. A salutogenic approach focuses on enhancing health, wellbeing and healthy behaviour, in contrast to a pathogenic approach that focuses on prevention or reduction of diseases and unhealthy behaviour. An example of an environment where a salutogenic approach is leading is palliative care for people in their final stage of life. Recovery is no longer expected. The focus shifts towards supporting patients and their families in maintaining a certain quality of life, both emotional and spiritual (Golembiewski, 2010; Rosenberg & Hammill, 2015).

The distinction between a salutogenic and pathogenic approach is highlighted in the work of Antonovsky (1987, 1996), a medical sociologist, who wondered why stress can make certain people sick and others are able to cope with it and remain healthy. Antonovsky (1987) developed a sense of coherence framework about individual perceptions of the extent to which events occurring around them are structured, predictable, and explicable (comprehensibility), the extent to which the individual has sufficient skills and perceives sufficient resources to meet the challenges posed by the environment (manageability), and the extent to which events are perceived as challenges worthy of investment and engagement (meaningfulness). Eriksson and Lindström (2006) developed a Sense of Coherence (SOC) scale, Bringsén et al. (2009) a Salutogenic Health Indicator Scale, and Nilsson et al. (2013) the Work Experience Measurement Scale (WEMS). These instruments make it possible to assess the relationship between SOC, health, and workplace experience and can be used in health-promotive workplace design and management.

Based on a narrative review of the literature, Roskams and Haynes (2020a) explored how the physical work environment could influence an individual's sense of coherence. The discussion is positioned in the environmental demands–resources model and linked to Herzberg's hygiene factors and motivators. The authors aim to contribute to a better understanding of the effects of the workplace environment on knowledge worker's job performance and the extent to which employees are able to minimize pathogenic “demands” and maximize salutogenic “resources”. It was found that comprehensibility can be supported by effectively implementing a clear set of rules governing the use of the workplace. On the other hand, background speech is a common concern in open-plan offices and has been found to be especially disruptive if it is unpredictable or judged to be inappropriate for the context. Manageability can be supported through biophilic design solutions, and through design which supports social cohesion and physical activity. Social support helps employees to effectively mitigate workplace stress. Workplaces with strong perceived social support are associated with higher job satisfaction, higher morale, lower absenteeism, and reduced turnover intentions. Meaningfulness can be supported by recognizing the importance of personal identity expression and through design which reinforces the employees' sense of purpose and supports personal identity expression. In offices where it is permitted, up to 90 per cent of employees decorate their workspace with items and/or photographs with rich personal significance, particularly those which reflect personal relationships with family and friends (Wells & Thelen, 2002). Personalization behaviour is a contributor to workplace well-being, particularly for women (Wells, 2000). Interview data confirmed that behaviour is at least partially motivated by the desire to give a sense of meaning to the workplace (Brunia & Hartjes-Gosselink, 2009).

BIOPHILIC DESIGN

Biophilia refers to love for nature and can be described as the innately emotional affiliation of human beings to other living organisms (Wilson, 1984). Biophilic design focuses on strengthening the connection with nature, i.e. by natural light, views on nature, pictures of nature, the indirect evocation of nature through biomorphic forms and patterns, or design which mimics the spatial configurations found in nature, plants, water, and natural materials (Browning et al., 2014; Ryan et al., 2014; Design/Curial, 2019). Biophilic design solutions enable employees to more effectively cope with workplace stressors. Demonstrated benefits of biophilic design have included fewer reported health ailments, higher satisfaction with the workplace environment, improved attentiveness, improved information management and processing, greater attention capacity, higher self-rated productivity and reduced stress (Lohr et al., 1996; Kaplan, 1993; Nieuwenhuis et al., 2014). Terrapin Bright Green (2012) presents examples of small investments in providing employees access to plants, natural views, daylight, and other biophilic design elements, with very positive returns.

It has been suggested that the benefits of nature arise due to the inherent stress-reduction properties of natural features, and the “softly fascinating” properties of nature that engender micro-restorative experiences, which enable the depleted cognitive resource for directed attention to recover (Kaplan, 1993, 1995). The benefits of nature also extend to non-stressed and non-depleted individuals, termed an “instorative” effect (Beute & De Kort, 2013). Roskams and Haynes (2020b) found that participants who took their break in a regeneration pod reported lower post-break anxiety and perceived task-load, and higher post-break arithmetic task performance than the control group. As such, biophilic design shows to function as a salutogenic resource, enabling the individual to more effectively cope with and recover from stressors in the workplace environment. For a deeper understanding of biophilic design see also Kellert (2018) and Kellert, Heerwagen & Mador (2013).

HEALTHY WORKPLACES

The term *Healthy workplaces* (HW) has been used widely in research on applied psychology. Grawitch et al. (2006) showed that the notion of Healthy workplaces has evolved over the past 60 years. In the 1940s, organizations began hosting outings and picnics for their employees. In the 1970s and 1980s, companies provided fitness programs for workers. Now, employees in companies worldwide are supported by various organizational programs to maximize employee health and the health of organizations. Remarkably, the understanding of HW in the article hardly considers the physical work environment.

A review by Forooraghi et al. (2020) showed that design considerations can be categorized in 1) a focus on health (e.g. active design, environmental design, participatory design, salutogenic design, sustainable design; 2) focus on users (agile design, co-design, evidence-based design, inclusive design and participatory design, performance-oriented design, sustainable and flexible design, user-centred design; and 3) office concepts such as cellular offices, open plan offices and activity-based (flexible) offices. Their paper presents a taxonomy of office design features and different types of health as well, see Table 1.

Table 1. Taxonomy of office design features in connection to health and wellbeing

Source:

(adopted from Forooraghi et al., 2020)

Office design features	Health
<p>Indoor environmental quality</p> <ul style="list-style-type: none"> - indoor air quality - daylight, artificial lighting - temperature, air quality, noise <p>Spatial features</p> <ul style="list-style-type: none"> - interior design e.g. use of texture, material, aesthetics, colour, plants, storage space, ergonomic design - spatial layout, e.g., proximity, active layout design, physical and psychological accessibility, wayfinding <p>Socio-spatial features</p> <ul style="list-style-type: none"> - control over environment, autonomy at work and work and empowerment - visual and acoustic privacy - territoriality/sense of ownership incl. space personalization, sense of belonging <p>Social features</p> <ul style="list-style-type: none"> - communication, collaboration, learning through providing formal and informal spaces <p>Non-space features</p> <ul style="list-style-type: none"> - tasks, task variety, activity profile, work styles - organizational characteristics, e.g., culture, leadership, strategic goals - organizational outcomes, e.g. productivity, sick time, costs, energy efficiency, staff recruitment, retention - person-related, e.g., age, gender, individual preferences, personality traits. 	<p>Physical health</p> <ul style="list-style-type: none"> - Sick Building Syndrome e.g. allergic reactions, fatigue, respiratory problems - musculoskeletal injuries e.g. neck aches, back pain - safety and hygiene <p>Mental health</p> <ul style="list-style-type: none"> - environmental stressor, e.g. lack of control, over the environment, lack of work autonomy, poor wayfinding - psychophysiological outcomes, e.g. anxiety, depression <p>Wellbeing</p> <ul style="list-style-type: none"> - mood, affects, comfort, satisfaction - personal growth, life management, social cohesion, sense of community <p>Salutogenesis</p> <ul style="list-style-type: none"> - salutogenic environment - positive and supportive built environment



Figure 2. Menzis Building in Enschede, the Netherlands

(Photos: Wouter van der Sar)

Menzis is a Dutch insurance company working in the health care sector, that puts much effort in creating a healthy work environment by a healthy indoor climate, physical activity, sufficient rest and relaxation, healthy food, collaboration, and autonomy in ways of working. Inter alia by providing a clear zoning system, a variety of (small clusters of) activity-based workplaces, advanced acoustics, relaxation spaces, sit-stand desks, welcoming staircases, living rooms, attractive sanitary provisions, natural forms and materials, a nice outdoor terrace, reduction of travel time, and a focus on people.

A great deal of available research focuses on Indoor Environment Quality (IEQ) and Indoor Air Quality (IAQ), such as noise and acoustics, light, temperature, humidity, presence of toxic materials etc. (Lahtinen et al., 2008; Clausen et al., 2009; Frontczak & Wargocki, 2011; Bluysen, 2015).

Regarding spatial, socio-spatial and social features, De Croon et al. (2005) found strong evidence that working in open workplaces reduces privacy and job satisfaction. Limited evidence is available that working in open workplaces intensifies cognitive workload and worsens interpersonal relations. A close distance between workstations intensifies cognitive workload and reduces privacy. No evidence was obtained for an effect on long-term reactions. In a more recent literature review, Colenberg et al. (2020) came to similar conclusions.

Erlich and Bichard (2008) studied to what extent open plan offices match the needs of older knowledge workers. This type of workplaces showed to provide well for collaboration and teamwork activities, but fail to provide an adequate environment for tasks requiring concentration, ways of working that are alternative to the computer, and rest and recuperation. In general, openness and proximity tend to facilitate higher levels of work-related and social interactions, but higher densities are also associated with increased distractions, increased physical discomfort, increased perceptions of crowding, and lower overall environmental dissatisfaction (Duval et al., 2002; May et al., 2005). This “privacy communication trade-off” has been highlighted as a key issue in modern open-plan offices (Kim & De Dear, 2013).

In a longitudinal study by Pejtersen et al. (2011) employees in cell-offices reported lower rates of sick leave than those working in open offices with more than six people. Cobaleda Cordero

et al. (2020) present a post-relocation study on the relationships between employee's well-being and office landscape. The case regards a division of employees at a Swedish university that moved from a cellular office to a combi office, still with assigned desks. The authors make a distinction between hedonic well-being, which refers to frequent positive feelings, infrequent negative feelings and overall life satisfaction, and eudaimonic well-being, which is associated with engagement, self-realization, autonomy and meaning in life. The findings reveal that spatial attributes such as visual openness influenced the hedonic components of affect and satisfaction and the eudaimonic components of social relations and environmental mastery.

A number of studies have also attempted to understand a variety of psychological responses to office design. For instance, territoriality, which is often expressed via the personalization of workspace, can positively influence well-being, employee attitudes and relationships among employees (O'Driscoll et al., 2006). Having insufficient control over environmental stressors, such as noise, disturbances and visual distractions, can have a negative effect on employee well-being, job satisfaction and motivation (Evans & Johnson, 2000; Banbury & Berry, 2005; Kim & de Dear, 2013). Autonomy at work i.e. the possibility to choose where and how to work, requires a variety of locations and workspaces that allow employees to match their choices to their activities, preferences and needs (Bodin Danielsson et al., 2014). Control is also closely related to privacy, which refers to the ability to avoid crowding by regulating interactions with other people (Ruohomäki et al., 2015). This ability could impact well-being and job satisfaction (Brennan & Chugh, 2002; De Croon et al., 2005).

Appel-Meulenbroek et al. (2020) found work overload to be the strongest predictor of the individual dimension of the Burnout-Engagement continuum i.e. exhaustion-energy, formal interaction to influence the interpersonal (cynicism-involvement) dimension, and work experience to have a significant impact on the self-evaluation (inefficacy-efficacy) dimension. Distraction has a direct and indirect (through overload) negative relation with the individual strain (meaning increased exhaustion). Office comfort has indirect positive relations (through recognition and appreciation) with the interpersonal strain (meaning increased involvement). The possibility for teleworking has an indirect positive relation (through control) on the self-evaluation strain (meaning increased efficacy).

Smith et al. (2011a) found a substantial reduction in sickness absence in an office area with plants. Smith et al. (2017) also identified a positive impact of plants on work environment aesthetics in an office with plants compared with a control office without plants in the same building. Bakker and Van der Voordt (2010) also found positive effects of plants on wellbeing.

To simulate activity, the use of fixed-height seated and standing desks, desktop height-adjustment stands or desks which are able to be adjusted between seated and standing positions could be considered (Jirathananuwat & Pongpirul, 2017). An interesting concept in this context is nudging: the use of cues that seduce people to healthy behaviour (Thaler & Sunstein, 2008). For instance, by locating stairs in clearly visible locations and making them more attractive, with the elevators a bit further away, in order to stimulate people to use the stairs instead of an elevator.

HEALTHY OFFICES / HEALING OFFICES

Whereas healthy workplaces is a rather generic concept, two related concepts focus on particular topics. In their book *The Healthy Office Revolution*, Nelson and Holzer (2017) present the findings of various studies into the impact of healthy food, less coffee, less sugar, mental wellness through yoga and mindfulness, physical activity by using standing desks and desk bikes, better lightning and the use of natural elements such as plants. All interventions showed to have a positive impact on perceived individual employee performance (plants: 10%;

healthy nutrition: 45%; healthy lighting: 12%; mental balance: 30%; and physical exercise: 12%). Employees also showed to be more happy, alert and motivated. Sound showed to be one of the most influencing factors. By using wearables, employees are made more aware of their life style and sleeping pattern. So far, nothing is known about long term effects.

A second particular concept is the Healing Offices design concept (Bauer, 2020). This concept has been developed by the design studio D/DOCK in Amsterdam, the Netherlands. It has been tested by a comparison between a pre-measurement at an IT company's old workplace and a post-measurement in the new location with a new office design (Bauer, 2020). The independent variable is the objective quality of the physical work environment, which was determined by an interior quality index. The interior quality index includes ten factors: healthy food, physical activity, re-energizing, nature, (day)light, connectedness, sense of ownership, diversity, sustainability, and indoor environmental quality, summing up to a maximum of 100 credit points. The dependent variables were the perceived health, engagement, comfort and productivity, assessed by an online questionnaire and interviews.

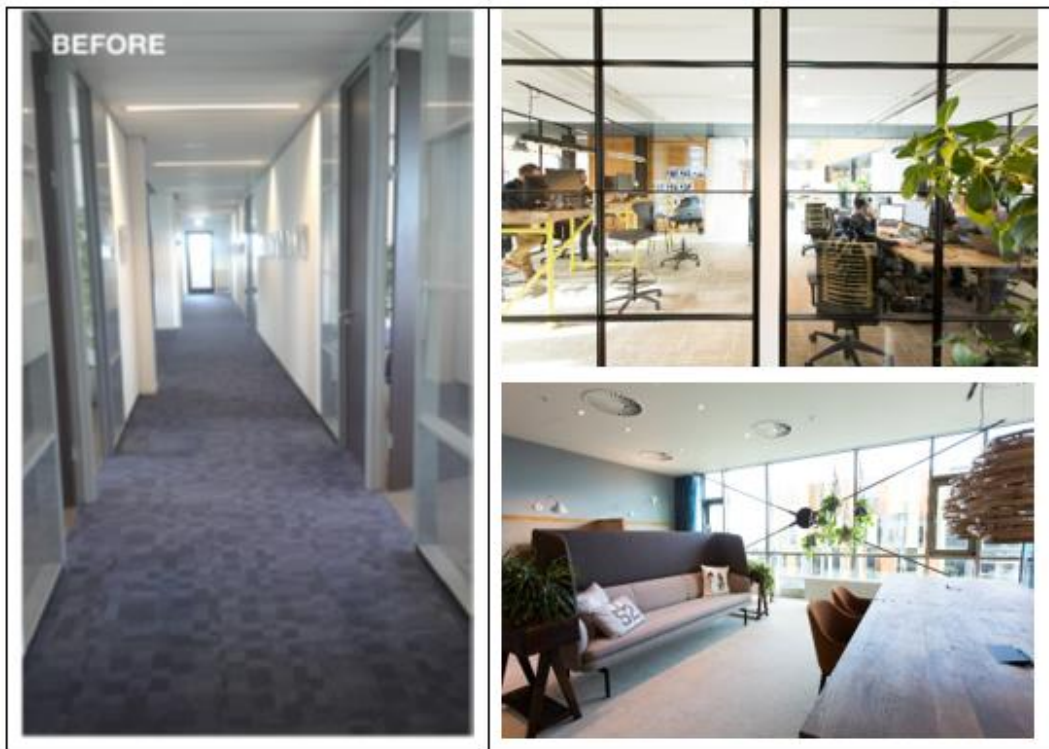


Figure 3. Images of the case studied by Bauer (2020)

(Photo old situation: Anicee Bauer; photos new situation: Karen Steenwinkel)

The old situation consisted of a mix of cellular offices and open landscape offices with shared desks, and traditional meeting spaces. The new situation is a full serviced Cradle to Cradle optimized work area, with more open spaces, a variety of work settings and meeting rooms, phone booths, playing devices, a focus room, and a huge void with a rooftop window that connects the two floors

The old environment received 41 credit points out of 100 in total, whereas the new environment scored 74 credit point. Sustainability increased the most, followed by diversity, nature, physical activity and re-energize. The subjective experience of employees also improved, specifically regarding feelings of comfort and energy, possibly because of a more inspirational and diverse environment. This also better captured the company identity. A more connected workspace seemed to relate to more physical activity and personal contact, as well as to teamwork and productivity.

SICK BUILDING SYNDROME / TOXIC WORK ENVIRONMENTS

Bergs (2002) opposed the term Healthy Buildings to Sick Buildings in Sick Building Syndrome (SBS). SBS is mainly pathogenically oriented and focuses primarily on reducing or avoiding sickness and diseases due to a poor indoor environment quality and other factors that contribute to symptoms related to the mucous membranes (i.e. the eyes, nose and throat), dry skin, headache and lethargy (e.g. Gao & Lau, 2012), and difficulty in concentrating and headaches (Goyal & Khare, 2011). Here too, indoor air quality and plants are the most studied influencing factors, whereas some studies regard the spatial layout of office buildings.

Gou and Lau (2012) present a SBS-survey in open-plan offices concerning indoor plants, workstation partitions, operable windows, and indoor environmental characteristics such as thermal comfort, air quality, noise and lighting. The study used the Building Use Studies questionnaire and included 30 offices of building-related professionals in Hong Kong. The results showed that indoor plants and operable windows were related to a reduction of SBS symptoms, while workstation partitions did not affect the incidence of SBS symptoms.

Smith and Pitt (2009) argue that plants are important in removing indoor air pollutants and increasing employee perceptions of wellbeing. From a perception survey in one office building the paper shows that occupants of planted offices feel more comfortable, productive, healthy and creative and feel less pressure than occupants of non-planted offices. Smith and Pitt (2011b) measured relative humidity, carbon dioxide, carbon monoxide and volatile organic compounds (VOCs). The results showed that relative humidity increased following the introduction of plants and more significantly following additional hydroculture plants being installed.

Schlittmeier and Liebl (2015) found that acoustics is the subjectively most important workplace factor followed by air quality, temperature, privacy, size of workstation, lighting, and access to windows. Irrelevant background speech is the most serious noise problem in open plan offices for employees who are supposed to do silent, concentrated work. Background speech intelligibility and overall noise should be diminished, but a room should not become excessively silent.

Toxic workplaces

Too and Harvey (2012) investigated unhealthy workplaces under the name of toxic workplaces, i.e. physical workplaces that are harmful to employees on a day-in and day-out basis. Their literature review investigates the links between physical workplace and social behaviour. The sources of toxicity include the barriers to free flow of employees, obstacles to face-to-face communications and electronic contact, and lack of personal privacy. Two dysfunctional social behaviours are highlighted: bullying and destructive leadership. The paper presents a logical plan to monitor and remediate the toxic conditions. The findings are synthesised in a framework for understanding the cause of toxicity in the workplace and a self-auditing preventive strategy.

REFLECTIONS AND CONCLUSIONS

The discussed design concepts have much in common, but also show different focus points. They vary from rather generic till more specific, from a focus on health care facilities to offices and workplaces, and from a focus on promoting and supporting health and wellbeing versus avoiding health problems and diseases.

The findings show that environmental determinants, including the built environment, can be a supporting factor as well as a risk factor. Overall, there appears a growing consensus about the positive impact of:

- an appropriate building lay-out, in particular a sound balance between openness and closed spaces and proximity versus appropriate density, opportunities for communication and concentration, privacy, and territoriality;
- nice interior design (colours, materials, finishing, ergonomic furniture, art);
- opportunities for personalisation;
- contact with nature (plants, view on nature, pictures of nature);
- a healthy indoor climate regarding temperature, humidity, air quality, lighting, acoustics,
- appropriate services such as healthy food and drinks

and a negative impact of:

- poor acoustics
- lack of privacy
- stress due to too much distraction
- toxic environments with an unhealthy indoor air quality.

The impact of design can be direct, e.g. by providing a healthy indoor climate and stress reducing facilities, or indirectly, by stimulating healthy behaviour such as physical activity (e.g. by providing sit-stand desks or desk bicycles, nudging), and social interaction (e.g. by creating interesting walking patterns within a building).

The current paper shows that health-promotive building design has a wider scope than just building design and also regards facilities and services. As such, a multi- or transdisciplinary approach and collaboration between designers, corporate real estate and facilities managers, human resource managers, IT specialist, clients and end users is needed.. Furthermore, a better integration between design and research could contribute to healthy environments (Hamilton, 2016).

Suggestions for further research

Although the body of knowledge on healing architecture is growing fast, still much work has to be done. The current findings highlight various challenges for this emergent field, in particular a lack of clear definitions and operationalisations of health, healthy and healing environments, ambiguous design strategies, and a lack of a holistic design approach. A next step could be to extend the literature search to inter alia healthy school buildings, healthy neighbourhoods, and healthy cities. In order to collect further empirical evidence, conducting new experiments, surveys, data collection using technical devices, interdisciplinary workshops and so on is an important follow-up a well.

A third next step could be to harmonize and integrate various conceptual frameworks regarding the independent variables (physical determinants of health and wellbeing) and dependent variables (different types of health and wellbeing and ways to measure). Currently many different frameworks are available (e.g. the WELL standard, the features mentioned by Pelikan et al., 2001, and Harris et al., 2002; the ten design qualities mentioned by Bauer (2020), and the environmental determinants mentioned by Forooraghi et al. (2020). These frameworks partly overlap and partly include different features, and are not always consistent

in the distinction between building features and impacts of building features such as restoration capacity. A common framework could be helpful to summarize the available evidence per factor in different sectors (offices, health care facilities, school buildings, industry) in connection to different target groups (staff, patients, visitors, students, community), using performance indicators such as end user satisfaction, health and wellbeing, absence to sick leave and treatment time in health care facilities. Besides, using a common framework supports the comparability of research findings and output and outcomes in practice.

It is also relevant to further elaborate and develop practical tools for the briefing and design process and management of buildings-in-use, based on a consistent and holistic vocabulary, preferably by building on existing ones such as the WELL Building standard, the Sick Building Syndrome checklist, or the checklist that has been developed by Herweijer-Van Gelder (2016) to support evidence-based design of (Dutch) hospitals.

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