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The relationship of physical, digital and social work environment changes with the development of organizational performance in the activity-based work environment

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Abstract

Purpose – Work environments are undergoing a transformation where organizations have various spatial solutions at their disposal. However, organizations may have challenges in making the right decisions in a work environment change, when the spatial solution is only one dimension of the work environment. The purpose of this paper is to approach this problem in a holistic way and explain the relationship between work environment changes and the development of organizational performance in the activity-based work (ABW) environment.

Design/methodology/approach – The results are based on an extensive quantitative survey involving 471 participants. The survey was theory driven and built on former literature. The participants were randomly collected from the largest cities in Finland, and the data were analyzed with a regression analysis.

Findings – The results showed that ABW environments require no more attention to the different work environment dimensions when compared to other office types, with the exception of the social work environment; the changes of which have a relatively strong relationship with the development of organizational well-being. In the ABW environment, a change in the physical work environment has a stronger relationship with the development of organizational productivity and a change in the social work environment has a stronger relationship with the development of organizational well-being than a change in the other work environment dimensions.

Originality/value – This study yields empirical evidence of the relationship of physical, digital and social work environment changes with the development of organizational performance in the ABW environment. The value of this paper is that it offers a simple but holistic research model to distinguish



the outcomes between the different work environment dimensions so that relevant expertise is applied to take concrete and targeted action.

Keywords Organizational performance, Productivity, Well-being, Activity-based work environment, Physical, digital and social work environment, Work environment change

Paper type Research paper

1. Introduction

Work environments are undergoing a transformation where the rapidly evolving technology changes business models, working methods, organizations and the labor market. In the information society, the importance of the individual has grown, knowledge work has turned location-independent and organizations are becoming more flexible regarding how, where and when the work is performed (Van der Voordt, 2004; Bodin Danielsson, 2010; Palvalin and Vuolle, 2016; Harris, 2016).

The aim of this paper is to explain the relationship of physical, digital and social work environment changes with the development of organizational performance in the activity-based work (ABW) environment. The research is deemed necessary to support business decisions with knowledge of the change-induced consequences, which, according to previous research, remains scarce (Van der Voordt, 2004; Van der Voordt *et al.*, 2012; De Been and Beijer, 2014; Riratanaphong and Van der Voordt, 2015; Palvalin and Vuolle, 2016; Haapakangas *et al.*, 2018b). ABW environments divide opinions for and against (Appel-Meulenbroek *et al.*, 2011; Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Appel-Meulenbroek *et al.*, 2015; Brunia *et al.*, 2016; Budie *et al.*, 2018; Hoendervanger *et al.*, 2018), which is why recent research aims to complement prior findings with new approaches to analyzing work environment changes in the knowledge work context (Harris, 2016; Palvalin and Vuolle, 2016; Budie *et al.*, 2018; Palvalin, 2019). Despite several notable studies regarding work environment influences on individual and organizational performance, only few empirical analyses address these influences in a holistic way, taking into account the physical, the digital and the social work environment dimensions (Palvalin, 2019; Gjerland *et al.*, 2019). Research distinguishing the outcomes between these dimensions remains limited, leaving a gap in existing literature. As a remedy, this paper strives to investigate the relationship of physical, digital and social work environment changes with the development of organizational performance in the ABW environment, with the help of former literature and a research model. The purpose is to ensure relevant expertise when pursuing concrete and targeted action. This is considered especially important when changes in the physical, digital and social work environment require multidisciplinary expertise. This paper complements prior findings and offers novel empirical data on the outcomes when the work environment dimension changes.

This paper begins with a literature review in Section 2 of performance management and prior studies associated with the relationship between work environments and organizational performance, which forms the background for the hypotheses. In Section 3, the survey research is designed and implemented. The hypotheses are tested with linear regression and the results are analyzed in Section 4. Finally, Section 5 concludes this paper with theoretical and practical implications, as well as with recommendations for further research.

2. Literature review

2.1 Performance management

Performance management has a long history, focused in the early 20th century on productivity management, from the 1930s to the 1970s on budgetary control, in the 1980s

and 1990s on integrated performance measurement and in the beginning of the 21st century on integrated performance management (Bititci *et al.*, 2012). Measuring non-economic values such as environmental and social performance became more common in the 1980s and in the 2010s performance management extended to social capital, values of innovation and intellectual property (Bititci *et al.*, 2012). Consequently, the people in the organizations and their well-being can be seen as an important performance metric among other variables.

Well-being at work can be defined in many ways and the definition is in constant shift because of changes in society, technology and new knowledge (Foldspang *et al.*, 2011). In a simple way, well-being at work can be divided into two elements:

- (1) the physical; and
- (2) the psychological and psychosocial elements.

However, these elements may interact, have short- or long-term effects and their interpretations may be objective or subjective (Foldspang *et al.*, 2011). Measuring physical well-being at work is less complex, as cause and effect are typically observable and interpretations objective. Measuring psychological and psychosocial well-being at work can be more challenging because of the interplay of several factors related, among others, to the organization, management and work culture. All this hinders the tracing of causes, possibly yielding only subjective effects (Foldspang *et al.*, 2011).

Productivity is commonly defined as the ratio between output and input (Van der Voordt, 2004). Although the productivity of knowledge work can be defined in the same way, there is no single acknowledged method to measure knowledge work productivity (Bosch-Sijtsema *et al.*, 2009). The challenge may lie in the intangible character of knowledge work. The productivity of the knowledge worker may vary widely depending on the work task, contextual factors associated with physical, digital and social work environment dimensions and individual skills and competences (Bosch-Sijtsema *et al.*, 2009). The productivity of knowledge work can be divided into different levels, such as individual and team levels, as well as into quantitative and qualitative dimensions (Palvalin *et al.*, 2017). Analyzing productivity outcomes on the team level could be appropriate when knowledge work is in practice performed as a team or in networks (Bosch-Sijtsema *et al.*, 2009; Nenonen *et al.*, 2009). This was the motivation for selecting the organizational level for productivity and well-being outcomes in this study, extending prior knowledge of the individual level. In this study and context, organizational productivity and well-being refer to how an individual perceives them subjectively.

2.2 Former studies of the relationship between work environment and organizational performance

Several notable studies from the 21st century associate the work environment influences with individual and organizational performance, e.g. Van der Voordt (2004), Bodin Danielsson (2010); Riratanaphong and Van der Voordt (2012), De Been and Beijer (2014); Brunia *et al.* (2016), Palvalin *et al.* (2017); Budie *et al.* (2018); Haapakangas *et al.* (2018b); Hoendervanger *et al.* (2018, 2019); and Groen *et al.* (2019). Spatial solutions in work environments can affect well-being and productivity, but the outcomes are also affected by many other factors, such as the organization itself, individual preferences and needs, work culture and management (Van der Voordt, 2004; Bodin Danielsson, 2010; Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Brunia *et al.*, 2016; Budie *et al.*, 2018; Palvalin, 2019). The influence of the work environment and new ways of working on individual and organizational performance have been researched in recent years by at least

the following researchers: [Brunia et al. \(2016\)](#), [Budie et al. \(2018\)](#); [Haapakangas et al. \(2018a, 2018b\)](#); [Hoendervanger et al. \(2018, 2019\)](#); [Palvalin \(2019\)](#); and [Bergsten et al. \(2021\)](#).

[Brunia et al. \(2016\)](#) explored the effects of various physical, digital and social work environment factors on employee satisfaction and perceived productivity in different ABW environments. [Budie et al. \(2018\)](#) analyzed the impact of individual needs on employee satisfaction and organizational performance in various physical work environments. [Haapakangas et al. \(2018a\)](#) examined the physical work environment and the importance of quiet spaces in an open office and the diverse variables affecting organizational performance. Further, [Haapakangas et al. \(2018b\)](#) explored self-rated productivity and employee well-being in the ABW environment, considering the role of environmental perceptions and workspace use. [Hoendervanger et al. \(2018, 2019\)](#) investigated perceived satisfaction with the ABW environment, centering on the effects of the physical and the social work environment and on how individual differences and needs influence work-related outcomes. [Palvalin \(2019\)](#) sought ways of measuring knowledge work performance in the new ways of working context, taking into account diverse contributing dimensions: the physical, the digital (virtual) and the social work environment, as well as individual work practices and well-being at work. [Bergsten et al. \(2021\)](#) examined the importance of the social work environment and change-oriented leadership on perceived productivity when relocating to an ABW environment.

The above studies confirm that analyzing the influence of the work environment dimensions on individual and organizational performance is complex and that concrete actions require multidisciplinary expertise, depending on the work environment dimension. They also convey the ambiguous role of relationships between different physical, digital and social work environment variables and performance outcomes ([Van der Voordt, 2004](#); [Riratanaphong and Van der Voordt, 2012](#); [Brunia et al., 2016](#); [Haapakangas et al., 2018b](#); [Palvalin, 2019](#)).

2.3 Recent development of work environments

Flexible ways of working combined with ABW environments have created a work environment model that aims, as before, for better interaction and collaboration between employees and for space and cost savings ([Van der Voordt, 2004](#); [Hoendervanger et al., 2018](#)). The work environment model of today also aims to satisfy such psychological needs of knowledge workers as autonomy, by facilitating work independently of time, place and manner ([Brunia et al., 2016](#)). In addition, the work environment aims for a space in the organization that supports innovation and enhanced work culture, which also lowers the environmental load ([Van der Voordt, 2016](#)). Despite efforts to address psychological needs, the mental load in knowledge work has increased, as the boundary between work and private life blurs when people are constantly reachable ([Bodin Danielsson, 2010](#)). This increases the significance of work environments in which communality, interaction and well-being play a key role ([Bodin Danielsson, 2010](#); [Ruohomäki et al., 2019](#)).

Owing to these developments, the examination of work environments has extended from a mere focus on the physical work environment to such as the social environment ([Van der Voordt, 2004](#)). According to [Vartiainen et al. \(2007\)](#) and [Nenonen et al. \(2009\)](#), knowledge can be shared in physical, virtual, social and mental spaces, which aligns with [Nonaka et al.'s \(2000\)](#) concept of ba, which defines a unified knowledge creation platform. In recent years, work environments in the context of knowledge work have been defined in a holistic way through the physical, the digital (virtual) and the social environment ([Palvalin, 2019](#)). The physical environment includes the organization's facilities and spaces, such as workspaces,

meeting rooms, lounges and the related furniture, but may also include any physical space regardless of location where work takes place, such as home, transport vehicles and cafeterias (Vartiainen *et al.*, 2007; Palvalin, 2019). The digital environment may comprise information and communication technology (ICT) and refers to a collaborative virtual workspace between people (Vartiainen *et al.*, 2007; Palvalin, 2019). The social environment is not only a physical or a digital space where social interaction takes place; it may also embrace everything related to human interaction, organizational leadership and management practices as well as the overall atmosphere, work culture, work habits and interpersonal relationships (Vartiainen *et al.*, 2007; Palvalin, 2019).

2.4 Background for the hypotheses

The influence of the ABW environment on organizational performance has yielded conflicting results in former research (Van der Voordt, 2004; Appel-Meulenbroek *et al.*, 2011; Riratanaphong and Van der Voordt, 2012; Brunia *et al.*, 2016; Budie *et al.*, 2018; and Hoendervanger *et al.*, 2018). The contradiction in the findings may relate to changes within physical, digital or social work environment dimensions, possibly occurring in a relocation or an organizational development process, as described later in this section. Therefore, and primarily, it would be important to understand whether the ABW environment requires more attention to the different work environment dimensions than other office types do, when planning a work environment change. Drawing on this, *H1* and *H2* were formulated:

- H1.* The relationship between work environment changes and the development of well-being is stronger in the ABW environment than in the other office types.
- H2.* The relationship between work environment changes and the development of productivity is stronger in the ABW environment than in the other office types.

When observing in more detail prior studies associated with ABW environments, people consider the physical work environment as unsupportive of productivity when the spatial layout does not offer the right amount of spaces for privacy and concentration (Van der Voordt, 2004; De Been and Beijer, 2014; Brunia *et al.*, 2016; Haapakangas *et al.*, 2018b; Hoendervanger *et al.*, 2019). However, the results may vary, depending on individual and organizational differences and factors that are not related to the physical work environment (Van der Voordt, 2004). Another aspect to consider is that real-life use of ABW environments may differ from what they were intended for, affecting productivity after a relocation (Appel-Meulenbroek *et al.*, 2011) and emphasizing the role of the social work environment. Appel-Meulenbroek *et al.* (2011) highlighted the importance of ergonomics, ICT-systems, comfort and control of privacy and interaction, while Haapakangas *et al.* (2018b) emphasized privacy, communication, smooth workspace switching and the physical environment overall, supporting productivity in the ABW environment. Some of these factors are related to the physical work environment but also to the digital and the social work environment. The comprehensive empirical study by De Been and Beijer (2014) showed that ABW environments did not support productivity, privacy or concentration as effectively as room offices did. ABW environments succeeded in architecture and spatial design, whereas dissatisfaction resulted from indoor climate and ICT-systems, but the results varied depending on the organization and amount of work tasks requiring collaboration or concentration. Physical environments can affect well-being and productivity, but satisfaction with the organization itself can affect the results and should be further explored (De Been and Beijer, 2014). According to Hoendervanger *et al.* (2019), room spaces were perceived to support individual performance of complex work tasks better than open spaces

and correspondingly, open spaces were perceived to support performance of simple work tasks better than room spaces, emphasizing the role of the physical work environment. When personal needs for privacy were also taken into account, this factor became a significant driver, with a higher need for privacy causing more dissatisfaction, regardless of the space solution. However, the results may be affected also by other needs related to the social work environment, such as autonomy and relatedness, which were de-scoped as variables from this study (Hoendervanger *et al.*, 2019).

As a summary of the above findings, the physical dimension of the ABW environment would appear to significantly associate with productivity, although there are also other variables within the digital and the social dimension affecting results. Therefore, it would be important to understand whether a change in the physical work environment has a stronger relationship with the development of organizational productivity than changes in the other work environment dimensions. Based on this, *H3* was formulated:

H3. In the ABW environment, a change in the physical work environment has a stronger relationship with the development of organizational productivity than changes in the digital and social work environment.

When observing earlier studies associated with ABW environments and well-being, Hoendervanger *et al.* (2018) found that psychological needs and job characteristics might affect satisfaction with the ABW environment. Relatedness, cohesion and social interaction perceived to be strengthened in the ABW environment but were dependent on individual needs of interaction, whereas work autonomy was strengthened and affected by work culture (Hoendervanger *et al.*, 2018), accentuating the role of the social work environment. Negative effects were connected to the physical work environment, lack of privacy, especially for work that required concentration (Hoendervanger *et al.*, 2018). However, the effects of the ABW environment on social interaction have produced conflicting results. Interaction has been strengthened in the ABW environment (Brunia *et al.*, 2016; Bodin Danielsson, 2010) and especially for those for whom interaction and mobility are essential work-wise (Hoendervanger *et al.*, 2018). According to De Been and Beijer (2014), interaction was found, contrastively, to be impaired in an ABW environment. Bernstein and Turban (2018) demonstrated how digital interaction between people increased and face-to-face interaction decreased in an open work environment, which digresses from the general assumption that open work environments increase genuine face-to-face interaction. Overall, interaction also decreased because the reduced face-to-face interaction was not digitally replaced to the same extent (Bernstein and Turban, 2018), underlining the roles of all three work environment dimensions. Further, Haapakangas *et al.* (2018b) found a more pronounced importance of communication supporting well-being in the ABW environment, emphasizing the role of the social work environment. According to Ruohomäki *et al.* (2019), relocations from private rooms to the ABW environment were expected to yield negative effects on well-being, but employee opinions were inconsistent after the relocation. Bodin Danielsson (2010) defined the physical environment in the ABW setup as supportive of good health, well-being and job satisfaction. However, individuals' opinions varied, especially regarding shared facilities and workspaces, which may be explained for by their different spatial layouts, as well as by their different psychological needs (Bodin Danielsson, 2010), evidencing the roles of physical and social work environments.

As a summary of the above findings, the social dimension of the ABW environment would appear to significantly associate with well-being, although there are also other intervening variables within the digital and the physical dimension. Therefore, it would be important to understand whether a change in the social work environment has a stronger

relationship with the development of organizational well-being than changes in the other work environment dimensions. Accordingly, *H4* was formulated:

- H4.* In the ABW environment, a change in the social work environment has a stronger relationship with the development of organizational well-being than changes in the physical and digital work environment.

3. Methodology

3.1 Data collection

The research strategy was built on a quantitative survey with previous suitability for measuring knowledge work performance in work environment changes (Maarleveld *et al.*, 2009; Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Palvalin and Vuolle, 2016; Brunia *et al.*, 2016). The participants were randomly collected from the largest cities in Finland, and the questionnaire was answered anonymously. Anonymity was considered important so that the status of the employees would not significantly affect the results (Van der Voordt, 2004; Palvalin and Vuolle, 2016). A total of 1,100 responses were gathered with a digital questionnaire; of which, 471 individuals who had experienced a change in the work environment during the past five years were selected for a more detailed analysis, as the results may be affected by time. The survey was conducted during the period 13 November 2019–22 November 2019 and administered by Taloustutkimus Oy, allowing to reach a comprehensive sample of knowledge workers in a short time. The sample size was considered sufficiently large to represent Finnish knowledge workers and organizations in Western Europe with a similar working culture and a high degree of mobile work. An analysis of variance (ANOVA) was performed to examine the potential of non-response bias. The respondents were divided into two groups; early respondents and late respondents and differences in their responses were tested on all study items. The late respondents are likely to be similar to non-respondents (Armstrong and Overton, 1977). The ANOVA test revealed no significant difference (at the 0.05 significance level) between the responses of the two groups (significance levels varied between 0.162 and 0.897). Therefore, in the absence of non-response bias it can be concluded that the responses reflect the entire sample.

The survey included structured questions; of which, the first six were background questions addressing respondent gender and age, the size of the organization, the business and industry, the office type in use and the share of office presence (Table 1). For this paper, the four most common office types were selected for further analysis, as they also represent the dominating types in Western Europe, although there are some national differences (Bodin Danielsson, 2010; De Been and Beijer, 2014). The next two questions were the main questions of the survey, including four supplementary sub-questions each. The sub-questions focused on physical, digital and social work environment factors, which may affect perceived well-being and productivity. The sub-questions were drafted into as simple and unambiguous items as possible, to avoid misunderstandings. Two sub-questions asked about the physical work environment, two about the digital work environment and four about the social work environment. Questions related to the physical work environment emphasized versatility and comfort of the spaces, whereas questions related to the digital work environment focused on digital equipment and mobility, as they may remarkably affect well-being and productivity (Bodin Danielsson, 2010; Appel-Meulenbroek *et al.*, 2011; Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Brunia *et al.*, 2016; Budie *et al.*, 2018; Haapakangas *et al.*, 2018a, 2018b; Hoendervanger *et al.*, 2019). Questions related to the social work environment highlighted organizational culture, level of interaction and working methods and practices, as they also may

| | | (%) | (%) | (%) | Activity-based work environment |
|------------------|----|---|-----|------------------------|---------------------------------------|
| | | | | | |
| <i>Gender</i> | | | | | |
| Female | 49 | <i>Business</i> | | <i>Office type</i> | |
| Male | 51 | Professional, scientific and technical activities | 14 | Open | 31 |
| | | Manufacturing | 13 | Room | 30 |
| | | Information and communication | 13 | Combi | 17 |
| | | Administrative and support service activities | 13 | Activity-based | 9 |
| <i>Age</i> | | Human health and social work activities | 12 | Home | 8 |
| 18–25 | 2 | Wholesale and retail trade | 6 | Office hotel | 1 |
| 26–35 | 19 | Construction | 5 | Co-working | 1 |
| 36–45 | 31 | Transportation and storage | 4 | Other | 3 |
| 46–55 | 28 | Finance and insurance | 3 | | |
| 56+ | 20 | Education | 3 | | |
| | | Public administration and defence | 3 | | |
| | | Real estate activities | 3 | | |
| <i>Org. Size</i> | | Agriculture, forestry and fishing | 2 | | |
| One | 4 | Arts, entertainment and recreation | 2 | <i>Office presence</i> | |
| <20 | 17 | Accommodation and food service activities | 2 | <50% of work hours | 20 |
| 20–50 | 10 | Other service activities | 1 | 50–79% | 22 |
| 51–100 | 10 | Other | 1 | 80–94% | 27 |
| >100 | 59 | No response | 0 | >95% | 31 |

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Table 1.
Respondents'
background
information for the
entire sample

significantly affect well-being and productivity (Bodin Danielsson, 2010; De Been and Beijer, 2014; Brunia *et al.*, 2016; Budie *et al.*, 2018; Hoendervanger *et al.*, 2018; Bernstein and Turban, 2018; Haapakangas *et al.*, 2018b). Eight questions had multiple-choice options and another eight had five-point Likert-scales. The questionnaire was developed by the main author on the basis of former literature, taking into account the three former-mentioned work environment dimensions. A holistic approach was essential, as these three dimensions should not be examined separately (Vartiainen *et al.*, 2007; Palvalin and Vuolle, 2016; Palvalin, 2019).

3.2 Research model, implementation and analysis

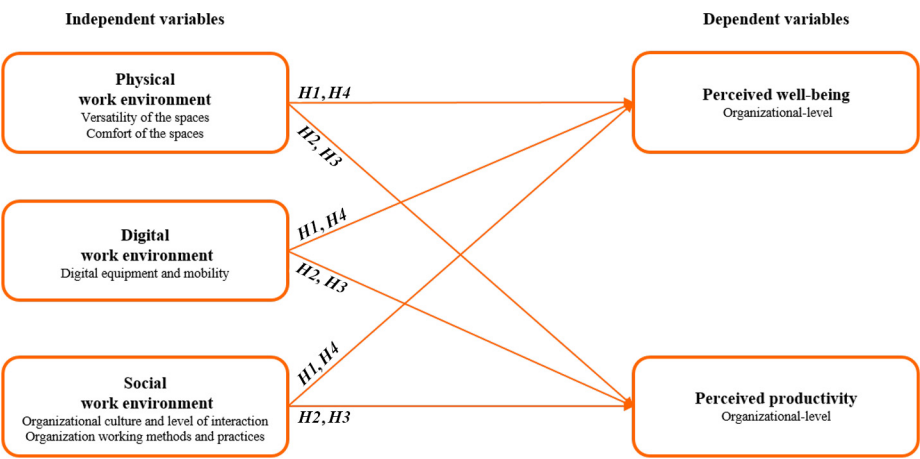
The research model for the survey was adapted from the framework developed by Palvalin (2019), who presented a method for knowledge work performance measurement in the new ways of working context, taking into account various contributing dimensions: the physical, the digital (virtual) and the social work environment, as well as individual work practices and well-being at work. In this study, the independent variables were limited to three:

- (1) the physical work environment;
- (2) the digital work environment; and
- (3) the social work environment.

Individual work practices, as well as well-being at work, can affect individual performance significantly (Palvalin, 2019), but these variables were not included in this study, as the main purpose was to explore the relationship between each work environment dimension and organizational performance, rather than to produce objective results of the whole. The dependent variables, the outcomes, were limited to two:

- (1) perceived well-being on organizational level; and
- (2) perceived productivity on organizational level. Based on this, a research model was developed (Figure 1).

Figure 1.
Research model



Construct measurement was performed for each independent variable to explore the reliability between the items. Cronbach's α for the three independent variables, the physical, the digital and the social work environment, yielded α -coefficients at a minimum of 0.861, which indicated internal consistency of the items. Table 2 summarizes the variables, the items per variable and the α -coefficients. The sub-questions regarding the independent variables had a five-point Likert-scale ranging from completely dislike (1) to completely like (5).

The hypotheses were tested with a linear regression analysis. Organizational well-being and organizational productivity are the two dependent variables. Two covariates, office presence and gender, were chosen for the regression analysis, as their impact has been recognized in earlier studies (Brunia *et al.*, 2016; Budie *et al.*, 2018).

4. Hypothesis testing

Table 3 summarizes the statistical means, standard deviations and correlations between the variables. Correlations varied between 0.164 and 0.714 and all correlations were significant ($p \leq 0.001$).

Hypothesis testing, regression results for the development of organizational well-being (Model 1) and organizational productivity (Model 2) are presented in Table 4.

H1 was partly accepted. The overall relationship between work environment changes and the development of well-being is strongest in the ABW environment ($R^2 = 0.364$) and weakest in the room office ($R^2 = 0.218$). It should be noted that a change in the office presence has a negative association with the development of well-being in the ABW environment ($\beta = -0.384, p \leq 0.001$). In other office types, there is no negative association according to the results ($p > 0.05$). The change in the physical work environment associates with the development of well-being regardless of the office type, most in the open office ($\beta = 0.433, p \leq 0.001$), least in the room office ($\beta = 0.314, p \leq 0.01$) and second least in the ABW environment ($\beta = 0.355, p \leq 0.05$). The change in the social work environment is connected to the development of well-being, emphasized in the ABW environment ($\beta = 0.401, p \leq 0.05$) and recognized in the combi office ($\beta = 0.318, p \leq 0.05$), but the significance levels are lower than in the open office ($\beta = 0.302, p \leq 0.01$). The change in the digital work environment has a negative association with the

| Construct | Items | α | Activity-based work environment |
|-----------------------------|--|----------|---------------------------------|
| Physical work environment | a. Our office workspaces are versatile and comfortable | 0.861 | 81 |
| Digital work environment | a. Our office workspaces are versatile and enables us to perform various tasks efficiently b. Our digital equipment enables us to perform tasks, regardless of location b. Our digital equipment enables us to perform tasks efficiently, regardless of location | 0.927 | |
| Social work environment | c. Our organizational culture is open, enabling smooth co-operation c. Our organizational culture and open flow of information enable us to perform tasks efficiently d. Our flexible working methods and practices enable us to perform tasks, regardless of time and place d. Our flexible working methods and practices enable us to perform tasks efficiently, regardless of time and place | 0.890 | |
| Organizational well-being | Do you feel that organizational well-being at work has increased in your current facilities, compared to your previous facilities? | | |
| Organizational productivity | Do you feel that organizational productivity at work has increased in your current facilities, compared to your previous facilities? | | |

Table 2.
Construct measurement and reliability

| Variables | Mean | SD | 1 | 2 | 3 | 4 | 5 |
|-------------------------------|------|-------|----------|----------|----------|----------|-------|
| 1 Physical environment | 3.33 | 0.948 | 1.000 | | | | |
| 2 Digital environment | 3.71 | 1.157 | 0.415*** | 1.000 | | | |
| 3 Social environment | 3.46 | 0.931 | 0.585*** | 0.714*** | 1.000 | | |
| 4 Organizational well-being | 3.01 | 0.963 | 0.470*** | 0.164*** | 0.362*** | 1.000 | |
| 5 Organizational productivity | 3.08 | 0.779 | 0.464*** | 0.171*** | 0.334*** | 0.646*** | 1.000 |

Table 3.
Means, standard deviations and correlations

Note: Significance level *** $p \leq 0.001$

development of well-being, and it is highlighted in the open office ($\beta = -0.231, p \leq 0.01$). In other office types, there is no negative association according to the results ($p > 0.05$).

$H2$ was rejected. The overall relationship between work environment changes and the development of productivity is strongest in the room office ($R^2 = 0.320$), weakest in the combi office ($R^2 = 0.267$) and in the ABW environment ($R^2 = 0.268$). It should be noted that a change in the office presence has a negative association with the development of productivity in the ABW environment ($\beta = -0.263, p \leq 0.05$). Other office types show no negative association according to the results ($p > 0.05$). The change in the physical work environment associates with the development of productivity regardless of the office type,

Table 4.
Regression results
for the development
of organizational
well-being and
productivity

| Model | All (<i>n</i> = 471) | | | Room office (<i>n</i> = 107) | | | Open office (<i>n</i> = 203) | | | Combi office (<i>n</i> = 93) | | | Activity-based (<i>n</i> = 68) | | |
|-----------------------------|-----------------------|----------|----------|-------------------------------|----------|----------|-------------------------------|----------|----------|-------------------------------|----------|----------|---------------------------------|----------|----------|
| | Std.β | <i>t</i> | <i>p</i> | Std.β | <i>t</i> | <i>p</i> | Std.β | <i>t</i> | <i>p</i> | Std.β | <i>t</i> | <i>p</i> | Std.β | <i>t</i> | <i>p</i> |
| <i>Model 1 Well-being</i> | | | | | | | | | | | | | | | |
| (Constant) | | 6.732 | 0.000 | | 4.772 | 0.000 | | 4.136 | 0.000 | | 2.434 | 0.017 | | 1.197 | 0.236 |
| Office presence | -0.007 | -0.169 | 0.866 | 0.032 | 0.352 | 0.725 | 0.021 | 0.353 | 0.724 | 0.052 | 0.547 | 0.585 | -0.384 | -3.582 | 0.001 |
| Gender | -0.053 | -1.339 | 0.181 | -0.111 | -1.218 | 0.226 | -0.062 | -1.056 | 0.292 | -0.022 | -0.235 | 0.815 | 0.056 | 0.534 | 0.596 |
| Physical environment | 0.410 | 8.185 | 0.000 | 0.314 | 2.821 | 0.006 | 0.433 | 5.821 | 0.000 | 0.401 | 3.575 | 0.001 | 0.355 | 2.425 | 0.018 |
| Digital environment | -0.230 | -4.022 | 0.000 | -0.220 | -1.510 | 0.134 | -0.231 | -2.709 | 0.007 | -0.235 | -1.797 | 0.076 | -0.209 | -1.508 | 0.137 |
| Social environment | 0.289 | 4.392 | 0.000 | 0.313 | 1.959 | 0.053 | 0.302 | 3.047 | 0.003 | 0.318 | 2.115 | 0.037 | 0.401 | 2.446 | 0.017 |
| <i>F</i> | 35.914 | | | 5.641 | | | 18.484 | | | 7.210 | | | 7.105 | | |
| <i>R</i> ² | 0.279 | | | 0.218 | | | 0.319 | | | 0.293 | | | 0.364 | | |
| <i>p</i> | 0.000 | | | 0.000 | | | 0.000 | | | 0.000 | | | 0.000 | | |
| <i>Model 2 Productivity</i> | | | | | | | | | | | | | | | |
| (Constant) | | 10.528 | 0.000 | | 6.253 | 0.000 | | 6.680 | 0.000 | | 4.154 | 0.000 | | 2.239 | 0.029 |
| Office presence | 0.015 | 0.369 | 0.712 | -0.065 | -0.755 | 0.452 | 0.099 | 1.627 | 0.105 | 0.016 | 0.161 | 0.872 | -0.263 | -2.289 | 0.025 |
| Gender | -0.090 | -2.264 | 0.024 | -0.179 | -2.120 | 0.036 | -0.132 | -2.177 | 0.031 | -0.016 | -0.162 | 0.872 | 0.142 | 1.263 | 0.211 |
| Physical environment | 0.425 | 8.399 | 0.000 | 0.390 | 3.754 | 0.000 | 0.424 | 5.554 | 0.000 | 0.413 | 3.615 | 0.001 | 0.425 | 2.700 | 0.009 |
| Digital environment | -0.154 | -2.673 | 0.008 | -0.108 | -0.792 | 0.430 | -0.190 | -2.175 | 0.031 | -0.149 | -1.116 | 0.267 | -0.147 | -0.991 | 0.325 |
| Social environment | 0.205 | 3.078 | 0.002 | 0.252 | 1.688 | 0.094 | 0.220 | 2.158 | 0.032 | 0.236 | 1.538 | 0.128 | 0.222 | 1.261 | 0.212 |
| <i>F</i> | 33.233 | | | 9.494 | | | 15.534 | | | 6.334 | | | 4.534 | | |
| <i>R</i> ² | 0.263 | | | 0.320 | | | 0.283 | | | 0.267 | | | 0.268 | | |
| <i>p</i> | 0.000 | | | 0.000 | | | 0.000 | | | 0.000 | | | 0.001 | | |

most in the ABW environment ($\beta = 0.425, p \leq 0.01$) and in the open office ($\beta = 0.424, p \leq 0.001$), least in the room office ($\beta = 0.390, p \leq 0.001$). The change in the social work environment is connected to the development of productivity and recognized in the open office ($\beta = 0.220, p \leq 0.05$). Other office types yield no association according to the results ($p > 0.05$). The change in the digital work environment has a negative association with the development of productivity, and it is recognized in the open office ($\beta = -0.190, p \leq 0.05$). In other office types, there is no negative association according to the results ($p > 0.05$).

H3 was accepted. In the ABW environment, a change in the physical work environment has a strong relationship with the development of organizational productivity ($\beta = 0.425, p \leq 0.01$). The change in the digital and the social work environment has no association with the development of productivity according to the results ($p > 0.05$). It should be noted that a change in the office presence has a negative association with the development of productivity ($\beta = -0.263, p \leq 0.05$).

H4 was accepted. In the ABW environment, a change in the social work environment has a stronger relationship to the development of organizational well-being ($\beta = 0.401, p \leq 0.05$) than the change in the physical work environment ($\beta = 0.355, p \leq 0.05$). The change in the digital work environment has no association with the development of well-being according to the results ($p > 0.05$). It should be noted that a change in the office presence has a negative association with the development of well-being ($\beta = -0.384, p \leq 0.001$).

5. Implications

5.1 Theoretical implications

When observing the results from the regression analysis, *H1* could only be partly accepted and *H2* was rejected. It seems that ABW environments require no more attention to the different work environment dimensions when comparing it to other office types, with the exception of the social work environment, which causes a relatively strong association with the development of organizational well-being. The change in the physical work environment has a positive association with the development of productivity, but the results are not noticeably conflicting when comparing the ABW environment to other office types. In summary, testing *H1* and *H2* could only partly explain former conflicting results regarding the influence of ABW environments on organizational performance, as noted by [Van der Voordt \(2004\)](#), [Appel-Meulenbroek et al. \(2011\)](#); [Riratanaphong and Van der Voordt \(2012\)](#), [Brunia et al. \(2016\)](#); [Budie et al. \(2018\)](#), [Hoendervanger et al. \(2018\)](#), and the phenomenon needs further research. The results from this study underline the importance of the social work environment in the ABW environment, which is recently reported also by [Appel-Meulenbroek et al. \(2015\)](#), [Brunia et al. \(2016\)](#); [Budie et al. \(2018\)](#); [Haapakangas et al. \(2018a, 2018b\)](#); [Hoendervanger et al. \(2018, 2019\)](#); [Palvalin \(2019\)](#); and [Bergsten et al. \(2021\)](#). *H3* and *H4* could be accepted for the ABW environment: a change in the physical work environment has a stronger relationship with the development of organizational productivity and a change in the social work environment has a stronger relationship with the development of organizational well-being than a change in the other work environment dimensions. Although these results are intuitive and the influences of various work environment factors have been examined broadly in prior research, they offer novel empirical data on the work environment changes that have a stronger relationship with organizational well-being and productivity than others in the ABW environment. Overall, the results of this study underline the importance of a holistic approach when exploring the relationship between work environment changes and the development of organizational performance, which has been documented also by [Vartiainen et al. \(2007\)](#), [Palvalin and Vuolle \(2016\)](#); and [Palvalin \(2019\)](#).

When observing the results from the regression analysis further, a negative effect was found for the covariant office presence, where a greater presence had a negative association with the development of well-being and productivity. This result could only be proven for the ABW environment, where employees might harness strong expectations regarding autonomy and decision-making. Budie *et al.* (2018) reported that people working in open offices and in ABW environments consider autonomy more important than do those working in other types of work environments. Hoendervanger *et al.* (2018) demonstrated that a higher degree of autonomy resulted in a higher degree of satisfaction in the ABW environment. Therefore, if these expectations regarding autonomy are not fulfilled, it may cause a negative association overall. Yet, another explanation for the negative association of office presence could be that the physical work environment might not be supportive of well-being and productivity if the spatial solution was originally designed mainly for mobile work and does not include the right amount of spaces for privacy and concentration (Van der Voordt, 2004; Appel-Meulenbroek *et al.*, 2011; Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Brunia *et al.*, 2016; Harris, 2016; Palvalin *et al.*, 2017; Budie *et al.*, 2018; Haapakangas *et al.*, 2018a, 2018b; Groen *et al.*, 2019; Hoendervanger *et al.*, 2019; Palvalin, 2019). However, these assumptions need further scrutiny to investigate the causal relationships between different variables.

5.2 Practical implications

The results of this paper can be applied to work environment change processes and to developing organizational operations generally. Knowledge about the relationship between different work environment dimensions and organizational performance is valuable to support the management in business decisions and work environment renewal, as well as to support property owners, developers and architects in the design of premises. Decisions regarding the work environment without knowledge of the consequences of the change could be harmful for the individual and the organization in many respects. However, with careful holistic consideration of the diverse work environment factors, the work environment change can be successful, supporting positive development of organizational performance. This paper offers a simple but holistic research model, which can be used for indicative research to distinguish the outcomes between the different work environment dimensions so that relevant expertise is applied to take concrete and targeted action. This is considered especially important when changes in the physical, digital and social work environment require multidisciplinary expertise.

The results explain which work environment changes have a stronger relationship with organizational well-being and productivity in the ABW environment. According to the results, the physical work environment requires consideration of the spatial layout to support productivity in the ABW environment. A practical solution could be spatial diversity, supporting interaction and especially concentration, which have been found important in previous analyses (Riratanaphong and Van der Voordt, 2012; De Been and Beijer, 2014; Brunia *et al.*, 2016; Budie *et al.*, 2018; Haapakangas *et al.*, 2018a, 2018b; Hoendervanger *et al.*, 2019). Additionally, the social work environment demands particular scrutiny to support well-being in the ABW environment. This could be solved with a transparent organizational culture where information flows and that offers the right level of autonomy for the knowledge worker, which have been found crucial (Budia *et al.*, 2018; Hoendervanger *et al.*, 2018). A practical solution could be change-oriented leadership and a widely participative implementation process, which have been shown to support organizational performance in a relocation (Brunia *et al.*, 2016; Bergsten *et al.*, 2021).

However, these suggestions call for further investigation within respective organizations and work environments.

6. Conclusions

As a summary of the findings in this study, the results underline the criticality of a holistic approach when exploring the relationship between work environment changes and the development of organizational performance. The relationship between the physical work environment and organizational performance has been examined broadly in prior research and the significance can also be seen in this study, regardless of office type. However, the social work environment should also be carefully considered with the help of relevant expertise, especially for the ABW environment.

A limitation of this research is that the measured outcomes are subjective and do not explain the actual productivity on the different levels and dimensions explained in Chapter 2.1. Another limitation is that this study addressed the three dimensions of the work environment, although there are also other variables such as individual work practices, well-being at work, intrinsic motivation and personal issues, which can affect individual and organizational performance. In this study, organizational well-being, as well as organizational productivity increased in some cases and decreased in others. However, the causal relationships between different variables and outcomes could not be proven. Future research requires careful examination of the questionnaire and additional questions examining other independent variables should be considered to fill gaps in the survey. Another limitation of this study is that the responses from people who worked in ABW environments were relatively few.

This study was conducted partly before the COVID-19 pandemic. One fundament of the ABW environment, already before the pandemic, is to grant individuals more freedom to define the way, the place and the time of work, to improve well-being and productivity. This implies several interesting topics for further research. Have attitudes changed toward ABW environments in the post-COVID-19 time? Are organizations from ABW environments supposed to suffer less from the COVID-19 in terms of individual and organizational performance, compared to organizations from other office types? Are there changes on the level of individual autonomy in the post- COVID-19 time, compared to pre-COVID-19 time and what are the influences of the autonomy level on individual and organizational performance? Accordingly, the authors of this paper will continue further investigating the relationship between work environment changes and the development of organizational performance.

References

- Appel-Meulenbroek, R., Groenen, P. and Janssen, I. (2011), "An end users perspective on activity-based office concepts", *Journal of Corporate Real Estate*, Vol. 13 No. 2, pp. 122-135.
- Appel-Meulenbroek, R., Kemperman, A., Van Susante, P. and Hoendervanger, J.G. (2015), "Differences in employee satisfaction in new versus traditional work environments", *European Facility management Conference, Glasgow*.
- Armstrong, J.S. and Overton, T.S. (1977), "Estimating nonresponse bias in mail surveys", *Journal of Marketing Research*, Vol. 14 No. 3, pp. 396-402.
- Bergsten, E.L., Haapakangas, A., Larsson, J., Jahncke, H. and Hallman, D.M. (2021), "Effects of relocation to activity-based workplaces on perceived productivity: importance of change-oriented leadership", *Applied Ergonomics*, Vol. 93 No. 2021, pp. 103348.

- Bernstein, E.S. and Turban, S. (2018), "The impact of the 'open' workspace on human collaboration", *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 373 No. 1753, p. 20170239.
- Bititci, U., Garengo, P., Dörfler, V. and Nudurupati, S. (2012), "Performance measurement: challenges for tomorrow", *International Journal of Management Reviews*, Vol. 14 No. 3, pp. 305-327.
- Bodin Danielsson, C. (2010), "The OFFICE – an explorative study. Architectural design's impact on health, job satisfaction and Well-Being", PhD Dissertation, KTH School of Architecture and Built Environment, Royal Institute of Technology, Stockholm.
- Bosch-Sijtsema, P.M., Ruohomäki, V. and Vartiainen, M. (2009), "Knowledge work productivity in distributed teams", *Journal of Knowledge Management*, Vol. 13 No. 6, pp. 533-546.
- Brunia, S., De Been, I. and Van der Voordt, T.J.M. (2016), "Accommodating new ways of working: lessons from best practices and worst cases", *Journal of Corporate Real Estate*, Vol. 18 No. 1, pp. 30-47.
- Budie, B., Appel-Meulenbroek, R., Kemperman, A. and Weijs-Perree, M. (2018), "Employee satisfaction with the physical work environment: the importance of a need based approach", *International Journal of Strategic Property Management*, Vol. 23 No. 1, pp. 36-49.
- De Been, I. and Beijer, M. (2014), "The influence of office type on satisfaction and perceived productivity support", *Journal of Facilities Management*, Vol. 12 No. 2, pp. 142-157.
- Foldspang, L., Mark, M., Puggaard, K.M., Poulsen, O.M., Johansson, U., Ahonen, G. and Aasnaess, S. (2011), *Measuring Work Well-Being and Productivity in the Nordic Countries*, Nordic Council of Ministers, Copenhagen, TemaNord 2011:569, p. 143, ISBN 978-92-893-2293-5.
- Gjerland, A., Søiland, E. and Thuen, F. (2019), "Office concepts: a scoping review", *Building and Environment*, Vol. 163 (October), p. 106294.
- Groen, B., van der Voordt, T.J.M., Hoekstra, B. and Van Sprang, H. (2019), "Impact of employee satisfaction with facilities on self-assessed productivity support", *Journal of Facilities Management*, Vol. 17 No. 5, pp. 442-462, doi: [10.1108/JFM-12-2018-0069](https://doi.org/10.1108/JFM-12-2018-0069).
- Haapakangas, A., Hongisto, V., Varjo, J. and Lahtinen, M. (2018a), "Benefits of quiet workspaces in open-plan offices – evidence from two office relocations", *Journal of Environmental Psychology*, Vol. 56 No. 2018, pp. 63-75.
- Haapakangas, A., Hallman, D.M., Mathiassen, S.E. and Jahncke, H. (2018b), "Self-rated productivity and employee well-being in activity-based offices: the role of environmental perceptions and workspace use", *Building and Environment*, Vol. 145 No. 2018, pp. 115-124.
- Harris, R. (2016), "New organizations and new workplaces", *Journal of Corporate Real Estate*, Vol. 18 No. 1, pp. 4-16.
- Hoendervanger, J.G., Albers, C.J., Mobach, M.P. and Van Yperen, N.W. (2019), "Perceived fit in activity-based work environments and its impact on satisfaction and performance", *Journal of Environmental Psychology*, Vol. 65 No. 2019, pp. 101339.
- Hoendervanger, J.G., Ernst, A.F., Albers, C.J., Mobach, M.P. and Van Yperen, N.W. (2018), "Individual differences in satisfaction with activity-based work environments", *PloS One*, Vol. 13 No. 3, p. e0193878.
- Maarleveld, M., Volker, L. and Van der Voordt, T.J.M. (2009), "Measuring employee satisfaction in new offices – the WODI toolkit", *Journal of Facilities Management*, Vol. 7 No. 3, pp. 181-197.
- Nenonen, S., Airo, K., Bosch, P., Fruchter, R., Koivisto, S., Gersberg, N., Rothe, P., Ruohomäki, V. and Vartiainen, M. (2009), "Managing workplace resources for knowledge work", ProWork Project Report.
- Nonaka, I., Toyama, R. and Konno, N. (2000), "SECI, ba and leadership: a unified model of dynamic knowledge creation", *Long Range Planning*, Vol. 33 No. 1, pp. 5-34.

- Palvalin, M. (2019), "Knowledge work performance measurement in the new ways of working context", Tampere University Dissertations 47, Faculty of Engineering and Natural Sciences Finland, ISBN 978-952-03-1054-7.
- Palvalin, M. and Vuolle, M. (2016), "Methods for identifying and measuring the performance impacts of work environment changes", *Journal of Corporate Real Estate*, Vol. 18 No. 3, pp. 164-179.
- Palvalin, M., Van der Voordt, T.J.M. and Jylhä, T. (2017), "The impact of workplaces and self-management practices on the productivity of knowledge workers", *Journal of Facilities Management*, Vol. 15 No. 4, pp. 423-438.
- Riratanaphong, C. and Van der Voordt, T.J.M. (2012), "Performance measurement of workplace change: a comparative analysis of data from Thailand, The Netherlands and Finland", in *The Added Value of Facilities Management: Concepts, Findings and Perspectives*, Centre for Facilities Management & Polyteknisk Forlag, Lingby.
- Riratanaphong, C. and Van der Voordt, T.J.M. (2015), "Measuring the added value of workplace change: performance measurement in theory and practice", *Facilities*, Vol. 33 Nos 11/12, pp. 773-792.
- Ruohomäki, V., Sirola, P. and Lahtinen, M. (2019), "Perceptions of satisfaction, collaboration, well-being and productivity after relocation to an activity-based office", *Conference paper, 50th Nordic Ergonomics and Human Factors Society Conference 2019*.
- Van der Voordt, T.J.M. (2004), "Productivity and employee satisfaction in flexible workspaces", *Journal of Corporate Real Estate*, Vol. 6 No. 2, pp. 133-148.
- Van der Voordt, T.J.M. (2016), *Design and Management of Activity-Based Workplaces*, Department of Management in the Built Environment, Faculty of Architecture and the Built Environment TU Delft, TU Delft Open, ISBN 978-94-92516-15-2.
- Van der Voordt, T.J.M., De Been, I. and Maarleveld, M. (2012), *Post-Occupancy Evaluation of Facilities Change*, *Facilities Change Management*, Wiley-Blackwell, Chichester, West Sussex, pp. 137-154, ISBN 978-1-4051-5346-1.
- Vartiainen, M., Hakonen, M., Koivisto, S., Mannonen, P., Nieminen, M.P., Ruohomäki, V. and Vartola, A. (2007), *Distributed and Mobile Work – Places, People and Technology*, VBIT Research Centre Helsinki University of Technology, Otatieto, Helsinki, ISBN 978-951-672-352-8.

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