A review of research in Activity-Based Working over the last ten years: lessons for the post-COVID workplace

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A review of research in Activity-Based Working over the last ten years: lessons for the post-COVID workplace

Abstract

Purpose: The aim of this review is to map and describe findings from research conducted in workspaces designed to support Activity-Based Working (ABW) over the last ten years (2010-2020) with a view of informing post-COVID workplaces of the positive and negative attributes of ABW.

Methodology: Scopus was used as the search engine for this review. Papers which reported findings related to ABW and performed field study in ABW workspaces with adult occupants were included. Out of the 442 initial papers, 40 papers were included following iterative title and abstract and full text review process and consideration of inclusion and exclusion criteria. These papers were divided into three groupings (organizational, human and physical environment) based on their major focus. Positive and negative effects of ABW environments on occupants are discussed within these three topics in consideration of the implications for the post-COVID workplace.

Findings: Although the included studies were inclined to be either more positive (i.e., interior design), or negative (i.e., IEQ, productivity, distraction and privacy) in relation to various attributes of ABW, no single effect of ABW environments on occupants was in full agreement between the studies. The shortcomings of ABW environments are more related to how this way of working is implemented and how occupants use it, rather than the concept itself. A partial uptake of ABW leads to occupants’ dissatisfaction, lower productivity and lower well-being, while a holistic approach increases the chance of success. It is hypothesised that many currently reported negative aspects of the ABW concept might diminish overtime as ABW evolves and as new challenges arise. A continuous post-occupancy evaluation after relocation to an ABW-supportive environment can inform the organization about the changing needs and preference of the occupants, hence the organization can tailor the ABW solution to the arising needs. The interconnection between the three key ABW pillars (organizational, human and physical environment) is crucial to the success of this concept specifically in the context of the post-COVID-19 workplace.

Originality: The paper highlights the key shortcomings and limitations of studies produced over the last decade and identifies key gaps in the current body of literature. It provides a new insight on how findings related to open-plan offices designed to support ABW can be categorized on the three big heading of organizational, physical and human-related aspects, and further investigates the positive and negatives outcomes reported on ABW under these headings. It also and discusses how the findings arising from this literature review can inform the post-COVID workplace.

Keywords: activity-based working, workplace, organizations, human, physical environment, post-COVID workspace

Introduction

Activity-based working (ABW) can be defined as ‘workplace strategy that provides people with a choice of settings for a variety of workplace activities’ (JLL, 2012). An environment which is designed to support ABW provides people with a variety of zones and spaces purposively designed to support the full spectrum of work activities from individual to collaborative work, allowing people to find the spot that suits their task at hand (Appel-Meulenbroek et al., 2011). An uptake of ABW has been accelerated in Australia and around the world over the past 10 years (Gensler, 2020; Luff, 2018). Despite of its growing popularity, both industry and academic reports/publications (i.e., Gensler, 2020; Engelen et al., 2019) indicate there are mixed views from workers on their overall experience of working in ABW-supportive environments, including satisfaction, perceived productivity, and health outcomes.

In 2020, management of COVID-19 pandemic worldwide has pushed many knowledge workers away from their offices and into the homes. This process, together with positive cost-benefits to organisations from a reduced office footprint and the overall uncertainty of ongoing lockdown restrictions in response to the pandemic has prompted the organizations to leave many premium-rated CBD spaces empty. The remote working is also becoming the preferred option of many workers after experiencing the benefits of working away from office and at alternative times. Further, the rise of hybrid ways of working is prompting organisations to revisit the purpose of their offices along with the types of activities (e.g., collaboration and team work) that are best suited to take place in face to face (at the office), versus those activities (e.g., focused work) that can be performed online (away from the office) along with better (and new) ways to support people.
In moving forward, the WFH experiment of 2020 highlights one of the central messages of ABW: the mindset that work is something that gets done, not a place people go to. This mindset, already core to ABW practices and new ways of working more broadly, has perhaps never been more important than during the pandemic and very likely beyond, whatever shape the post-COVID workplace will take. So, is there anything that can be learned from positive and negative aspects of ABW implementation when it comes to human, organisational and physical environment aspects that could inform workplaces beyond COVID?

From the organizational perspective, ABW rules, policies and concepts, if properly planned, designed and implemented well, and can play a significant role in its success (Babapour, 2019). An interactive communication with the employees initiated by the management before relocation to an ABW environment and continued after relocation can positively affect the long-term acceptance and success of this concept, and increase job satisfaction levels (Babapour and Rolfö, 2019). Organizational aspects are likely to continue as a key topic of concern in the post-COVID workplace as organizations start to set rules and policies to maintain culture, increase satisfaction and commitment among the workers in the new work arrangements.

From the physical environment perspective, despite the debate around the benefits and challenges of ABW environments, there is strong evidence that if the concept is executed well, the benefits far outweigh the challenges (Leesman, 2016). Occupants tend to appreciate features such as interior design (De Been and Beijer, 2014), with mixed opinions around Indoor Environmental Quality (IEQ) (Lusa et al., 2019), perceived productivity (Hoendervanger et al., 2016), and health (Candido et al., 2019). Aspects related to the physical environment are likely to continue and may morph into new areas of consideration in the post-COVID era when different physical environments might be known as the workplace including home offices and co-working spaces.

From the human perspective, personality, age and gender are among the human factors that have received attention, however much more research is needed to document the effects of these factors on satisfaction, health and productivity in the workplace. Research suggest that occupants with different personality traits might respond to an ABW environment in different ways in regard to overall satisfaction, level of distraction, perception of privacy and stress level. However, the diversity of spaces in an ABW environment may support people with different personality traits to find their favourite spot within the workspace. This factor is already a key topic of concern in the post-COVID workplace as various personality traits are showing different levels of flexibility and adoptability in the new work arrangements. Physical and mental well-being for remote workers has also hit various personality traits with different strength as the pandemic continues.

The aim of this systemized review is to map and describe findings from research conducted in workspaces designed to support ABW over the last ten years (2010-2020). The study provides a new insight on how findings related to open-plan offices designed to support ABW can be categorized on the three big heading of organizational, physical and human-related aspects. It further focuses on research findings reporting both negative and positive outcomes of ABW under these three headings and shed light on how these findings can be used to inform the post-COVID workplace. In addition, the paper highlights the key shortcomings and limitations of studies produced over the last decade and identifies key gaps in the current body of literature and discusses how ABW concept might evolve in the post-COVID-19 workspaces. The study also looks at the key words trends and their interconnection, the geographical locations of the academic research in this area and the frequency of papers published in each year over the last decade.

Methodology
This systemized literature review used Scopus as the search engine.

1. Search strategy
The search included papers published from 2010 until 2020, inclusive as this is the period of the greatest uptake of ABW around the world. It included filed study, combination of field studies and lab experiment, pre-post studies, case studies and cross-sectional studies. Keywords used for the search are depicted in Table 1. Our initial search used keywords including ABW, New Ways of Working (NWoW), and flexible working and returned a high number of articles from different disciplines as ABW is a common term in different fields. The subsequent search limited the scope by introducing a second keyword like office, workspace, or workplace to only consider the records relating the office workspace to occupants.

Study/paper selection
This search round returned 434 articles, plus 62 papers which were added from another source. One-hundred and ninety-three duplicates were removed, and for the remaining 244-247 records, titles and abstracts were screened for inclusion. Subsequently a further 154 papers were removed as they were irrelevant. The full text of 89-93 remaining
records were assessed for inclusion following which the final number of records included was 36-40 considering that several additional excluded studies referred to flexible working as “remote working”, “working from home” or “time-flexible working”. Figure 1 shows the search, screening and selection of the records based on the PRISMA statement.

Table 1: Search terms used for the systemised literature review

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<th>Term</th>
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<tr>
<td>ABW</td>
<td>new way of working</td>
<td>A-FO (Activity-based flexible working)</td>
</tr>
<tr>
<td>new office</td>
<td>mental health</td>
<td>activity-based office</td>
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<tr>
<td>flexible office</td>
<td>health</td>
<td>workplace</td>
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<tr>
<td>activity based working</td>
<td>task-based work</td>
<td>workspace</td>
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<tr>
<td>flex office</td>
<td>non-territorial work</td>
<td>office</td>
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<td>productivity</td>
<td>future ways of work</td>
<td>flexible work</td>
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<td>satisfaction</td>
<td>activity based flexible working</td>
<td>innovative office</td>
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<tr>
<td>indoor air quality</td>
<td>well-being</td>
<td>agile working</td>
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<tr>
<td>distraction</td>
<td>activity-based environment</td>
<td>mobile working</td>
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Figure 1: Flowchart of the searched and included papers

2. Inclusion and exclusion criteria

Two researchers (SM and CC) screened publication titles and abstract and discussed inclusion/exclusion of papers. Disagreements were resolved through consensus by reading the full paper. Table II represents the inclusion and exclusion criteria for this review study.

Table II: Inclusion and exclusion criteria

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<th>Studies were included if they:</th>
<th>Studies were excluded if they:</th>
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<tr>
<td>English full-text not available</td>
<td>Not ABW</td>
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<tr>
<td>Not ABW</td>
<td>Lab study</td>
</tr>
<tr>
<td>Considered NWoW as remote working, not ABW</td>
<td>Not reporting any clear outcome related to ABW</td>
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Studies included (n= 40)
were conducted as a field study in an activity-based workspace with adult occupants. (2) reported findings/outcomes on a specific aspect (human, organizational and physical environment) of activity-based workspaces. (3) collected pre- and post-relocation data when the post-relocation was ABW. (4) considered new ways of working and flexible working with some features related to ABW. (5) were peer reviewed. (6) have used another term like “flexible working”, but the study method and design clarified that the study was conducted in an ABW environment.

(1) investigated a standard office such as an open-plan or a private office but not an ABW environment. (2) conducted only simulation using computer-based programs. (3) did not have an available English full text. (4) considered new ways of working and flexibility in time and place only (non ABW), for example working from home.

3. Categorisation

Thirty-six papers were included for data extraction. Papers were initially analysed and categorized based on their major focus of ABW investigation (i.e., organizational, human, and physical environment), although it is not always possible to draw a distinct line between each of these three categories. Organizational factors are defined as factors that are directly affected by workplace management and the decisions people at managerial levels make. Human category includes individual differences in characteristics, thinking and behaviour which is not affected by external factors (e.g., personality, age and gender). Physical environment factors comprise of factors that are mainly affected by the design of the physical environment. Thirty-six selected papers were later grouped according to the minor topic of investigation (see Figure 2) related to these broad categories, including both positive and/or negative outcomes of the research.

Figure 2. Topics of investigation emerged from research papers in spaces designed to support ABW supportive environments

Results and discussion

1. Keywords trends (years and locations)

Figure 3 illustrates the network of keywords used by authors in different years for the 41 included papers. When looking at the keywords, the term “activity-based” has been used over the last decade albeit in slightly different forms. “Activity-based working” and “activity-based flexible office” are more recent terms compared to “activity-based workplace”, “flexible office” and “new way of working”. In addition, as seen in Figure 3, keywords like ‘switching behaviours’, ‘control’, and ‘activity-based workplaces’ were commonly used in 2016, while keywords in 2017 papers
were more inclined to focus on outcomes of ‘satisfaction’, ‘productivity’ and ‘work environment’. Although the papers published in 2019 and 2020 have used ‘activity-based working’, ‘productivity’ and ‘satisfaction’ as the main keywords, health-related keywords were also becoming more common. Workspace health promotion, ergonomics, sedentary behaviour, physical activity, person-environment fit, and well-being are each commonly keywords in recent papers. Hence, a slight shift to the health-related outcomes in the research can be seen.

Figure 4 illustrates a general increase in the publication frequency of ABW related papers since 2014, with the maximum number of papers published in 2019. Considering that the literature search was performed before the end of 2020, the total number of papers relevant to this review published this year is likely to exceed that of previous years.

Figure 5 shows the geographical locations of ABW related papers since 2010. The greatest number of papers have originated in Sweden and Netherlands, followed by Germany, Australia, Japan and Finland. Few academic ABW studies are published in U.S., however this country has established a strong industry-based research stream on different aspects of open-plan offices designed to support ABW. Papers published in Germany, have predominantly used “flexible working” as a keyword as a synonym for activity-based working. In contrast, “activity-based work/working” is the most frequently used keyword in studies published in Sweden, Australia, and Netherlands with less frequent use of “flexible work/working”. In addition, use of the abbreviation A-FO is also seen in some research from Sweden.

![Figure 3: Network of keywords for the 40 included papers (The dots show the keywords used in the academic literature in the last 10 years, and the lines show the co-occurrence of these keywords. The bigger the dot is, the more frequent the keyword is used in 41-40 papers investigated in this study. Different colours show the year the keyword was used in).](image-url)
2. Study types and methodologies

Around two-thirds of included papers used a post-occupancy study design to evaluate the ABW environment. Comparative studies based on pre- and post-field studies (n=124) account for less than half of the number of post-occupancy studies (n=296). One pre-occupancy study only evaluated employees’ expectation of the ABW environment they were going to relocate to (de Kok et al., 2016). Study sample sizes varied from 9 to 11799, and post-occupancy studies conducted in medium size (n=50-999) ABW environments were the most frequent type of included study (n=1922 papers). Eleven-Twelve studies utilized both subjective and objective methods for data collection, while most studies used only subjective methods (questionnaires and interviews). Studies are divided for analysis into three main categories: organizational (n=17-18 papers), human (n=27 papers) and physical environment (n=26-29 papers) as discussed in the methodology section.

3. Key topics of investigation

3.1. Organizational-related aspects

3.1.1. Policies and rules

Five included studies (Babapour and Rolfo, 2019; Babapour, 2019; Gocer et al., 2018; Budie et al. 2019; Babapour et al., 2018) evaluated policies imposed by the organization regarding use of shared facilities in workspaces designed to support ABW/A-FO. One study (Babapour and Rolfo, 2019) focused on policies and how the organization communicated these policies to the occupants. They found that extensive occupant involvement resulted in having clear and well-communicated rules and facilitated compliance with these rules by the employees. Another study (Babapour, 2019) reported that giving the employees flexibility to modify their workspace gave them the feeling that their needs had been met. Babapour et al. (2018) observed that after a period of familiarization with the new premises, a new speech policy for the open space was proposed by the occupants to minimize noise distraction. Further, Gocer et al. (2018) found that female workers were less satisfied with a clean desk policy compared to male workers due to more sensitivity to environmental factors. Additionally, Budie et al. (2019) found that increasing age negatively affected satisfaction with the regulation of interaction (communication, proximity of co-workers, concentration, privacy).

Policies for the use of the shared spaces and facilities in ABW-supportive environments and how these policies are communicated to the workers can play an important role in the acceptance of the ABW solution by the workers. In addition, workers’ involvement in modifying policies over time can lead to more satisfaction levels and increase compliance with the ABW rules.
3.1.2. Management

Five studies (Babapour, 2019; Ianeva et al., 2015; Rolfö, 2018; Wahlström et al., 2020; Brunia et al., 2016) investigated the effects of management support on occupants’ satisfaction or well-being regarding the implementation process in an ABW environment.

Babapour (2019) found that giving the employees continuous support and the opportunity to modify the workspace increased their feeling of ownership, appreciation of the ABW solution and increased perception of work support. A similar finding was highlighted by Brunia et al. (2016) who showed that employee satisfaction was (positively and negatively) influenced by the implementation process along with many physical characteristics (i.e., interior design, level of openness, and subdivision of space) of the work environment. Ianeva et al. (2015) also stated that a successful implementation process depended upon a better understanding of the ABW concept among the design and facility management professional communities as a situated approach in understanding work practices. A study by Rolfö (2018) showed that process factors such as having clear objectives, financial and time resources, employee participation and empowerment, and methodical approach contributed to a significant increase in perceived performance and environmental satisfaction with A-FOs. Wahlström et al. (2020) found a strong organizational culture that promotes health-related activities combined with facilitating a health-enhancing physical environment (i.e., sit-stand desk, walking meetings) can create sustainable positive physical activity behaviours in office settings.

The evidence suggests that there is an agreement in the importance of organizational aspect in success of an ABW environment and satisfaction of the occupants. Tailoring the ABW solution to the organization’s culture and asking the employees to actively contribute to organization’s decision before and after relocation increases the likelihood of success. The interrelation of organizational aspects with the human and environmental aspects is not well investigated in the current research. A well-organized relocation to ABW environment might not be accepted by the occupants if the physical design is not catering for these changes.

Post-COVID workspaces will accentuate the role of organizations and organizational management in the success of the solution even more than before. How the ABW concept, its policies and rules take different forms and shapes within each organization might be unique. Active engagement of occupants needs to commence in the planning step and continued after implementation of the concept.

3.1.3. Job satisfaction, work condition and organizational commitment

Three studies (Arundell et al., 2018; Wohlers et al., 2019; De Leede and Nijland, 2016) found positive associations between ABW and job satisfaction and work condition, while one study (Gocer et al., 2018) reported negative outcomes for job satisfaction, motivation and job performance in female workers only. Additionally, two studies (Mache et al., 2020; Babapour and Rolfö, 2019) reported both negative and positive outcomes for association between ABW and organisational variables (i.e., work condition, workload and mental demands).

Arundell et al. (2018) found meaningful improvements in job satisfaction and relationship between co-workers in ABW compared to a comparison non-ABW workplace. Wohlers et al. (2019) showed that availability of workspaces in ABW that supported undisturbed working was positively associated with job attitude. De Leede and Nijland (2016) found a direct positive relationship between new ways of working and organizational commitment. A study by Mache et al. (2020) showed that there was an increase in job autonomy and workload, and a reduction in mental demands with ABW-supportive environments. A comparative study (Babapour and Rolfö, 2019) reported positive effects of user involvement on work condition, along with negative effects of ambiguous rules on work condition. Finally, Gocer et al. (2018) reported that female employees were more affected by the noise and visual exposure compared to males, and these factors had negative impacts on the job satisfaction, motivation, and job performance. Whether relocation to an ABW-supportive environment can increase job satisfaction and/or organizational commitment is debatable as studies have reported both positive and negative outcomes.

3.1.4. Social relations

Social relation is used as a broad term to include communication, teamwork, collaboration and interaction. Ten studies investigated social relations in ABW environment with mixed evidence about the effects of ABW environments on these aspects. Five studies reported positive outcomes (Arundell et al., 2018; Gerdentisch et al., 2017; Budie et al., 2019; Divvet et al., 2020; Mache et al., 2020), while studies reported negative outcomes (Beijer, 2014; Haapakangas et al., 2019; Rolfö et al., 2018; Muhtonen and Berthelsen, 2020), and two (Wohlers and Hertel, 2018; De Been et al., 2015) reported both negative and positive outcomes within the same sample.

Meaningful improvements in relationships between co-workers, collaboration opportunities, frequency of eating lunch with colleagues (Arundell et al., 2018), satisfaction with communication while doing non-concentrated work (Budie et al., 2019), increased collaboration (Mache et al., 2020), increased productivity as a function of team interaction (Divvet...
at al., 2020), and increased perceived interaction across teams for participants reporting a better perceived need-supply fit (Gerdenitsch et al., 2017) were all reported in ABW environments.

In contrast, two studies reported less communication satisfaction in ABW offices (De Been and Beijer, 2014) and negative effects of an ABW office on social support and emotional demands (Haapakangas et al., 2019). Rolfö et al. (2018) found no significant change in the ease of interaction when comparing baseline (open-plan) and follow-up (ABW), along with a decline in the ease of interaction due to the long time spent on teamwork and lack of designated team areas. Two studies (Wohlers and Hertel, 2018; De Been et al., 2015) reported both negative and positive impact on social relations in ABW environments. Another study (Rosengren and Ottoson (2019) reported that the non-territorial foundation of ABW is seen as a threat to the work-related identity among certain groups within a studied organization.

In general, ABW users reported higher communication and interaction levels, but not all of them rate these aspects as a positive feature of an ABW environment. The higher communication level is mainly related to incidental communication with colleagues and easy inter-team collaboration because of openness of the work area, however the personal and private conversations suffer for the same reason. Less social bonding among the employees happens as the result of decreased personal conversations. Another dominant negative effect on communication is apparent among the team members because employees have the freedom to choose where to sit and the lower number of workstations provided in ABW office environments compared to traditional workspaces. This makes it more difficult to find other team members and working in teams more challenging. As a result, many workspaces have developed neighbourhoods to circumvent these issues. Moreover, the individual differences and the type of work people perform play an important role in how they rate social relations in ABW environments.

In the context of ABW environments before the COVID-19 pandemic, the barriers to effective communication obstacles can be related to high occupant-to-workstation density ratio, lack of clear rules, lack of designated team areas, and scattered distribution of team members. Little research has been conducted to identify strategies to optimise communication but generally, providing ample team zones and private zones may help solve the problem to some extent. In the context of ABW environments post-COVID-19, the issue with low number of the workstations and privacy might decrease due to the move to remote working, while new problems with communication have already arisen in the remote work arrangements. Use of new mobile technologies has helped easing the communication difficulties to some extent, however the existence of a physical office for the face-to-face collaboration seems necessary.

### 3.2. Human-related aspects

Five studies (Wadu and Chiang, 2019; Budie et al., 2019; Sugino et al., 2019; Christersson et al. 2017; Mache et al., 2020) investigated how human-related attributes can affect success of a workspace designed to support ABW. Wadu and Chiang (2019) showed that introverts generally preferred private workspaces. Extrovert respondents believed that the reduced personal storage and privacy negatively influenced their productivity. Budie et al. (2019) found that communication in ABW environments was positively associated with an extroversion personality trait but negatively associated with increasing age. They also reported that evidence of an association between gender and age on satisfaction scores was limited, in contrast to direct associations with varying personality traits. A further study by Sugino et al. (2019) observed that highly agreeable workers tended to be more distracted by the ICT and interior environment in ABW, while extraverts had an inverse correlation with distraction and were less easily distracted.

There was no meaningful correlation in included studies between age and distraction. It was also noted by Christersson et al. (2017) that different employees experienced relocation to the same ABW environment in different negative and positive ways. Mache et al. (2020) also reported a significant decrease in occupational stress of occupants after relocation to an ABW environment.

There is evidence that introvert and orthodox individuals not only have a bigger struggle to adapt to this new way of working, but also, they might undergo higher levels of psychological discomfort. How an ABW environment can be designed to suit various personality traits need more research, but it is likely that a variety of spaces with specific (e.g., focus, and private spaces) areas might release the pressure for some personality traits. In the context of the post-pandemic workspaces, there are two conflicting aspects that need more research: some personality traits might be already going through tougher struggles to be adapt to the new work arrangements, meanwhile because of the flexibility given to the workers, it might be easier for everyone to choose the way of working that suits themselves. It seems that the design solution for a post-COVID workplace will not only be unique to each organization, but also for each individual within the organizations as the need for flexibility is a core requirement.
3.3. Physical environment aspects

3.3.1. Overall satisfaction

The term “satisfaction” in the literature has a broad meaning when considering users’ satisfaction with ABW environments. Satisfaction is discussed under three domains: interior design, IEQ, and space utilization.

3.1.1. Interior design and space

Based on analysis of 9 included studies, there is strong evidence that satisfaction with the architecture, layout and interior design of a workspace designed to support ABW is much higher than a traditional office workspace. High satisfaction with architecture, layout and interior of a workspace (De Been and Beijer, 2014; De Been et al., 2015; Brunia et al., 2016, Lusa et al., 2019; Arundell et al., 2018), and higher overall satisfaction with the overall physical workspace (Shinoyama et al., 2019), outdoor view, and aesthetics (Rolfö et al., 2018) was reported in the literature. Similarly, Rolfö (2018.a) reported a noticeable increase in satisfaction with the physical environment and an increase in the number of occupants preferring the A-FO as their way of working after occupants relocated to an A-FO environment as well as an increase in the number of occupants preferring the A-FO as their way of working. A further study by Hoendervanger et al. (2016) reported that workers who switch between different workstations several times were more satisfied, while another study (Budie et al, 2019) highlighted that satisfaction with the workplace is the result of person-environment fit, including both environmental and personal factors. Rolfö (2018.b) showed that a high preference for the A-FO was correlated with an A-FO preference prior to relocation, being a former open-plan office occupier and with frequent performance of innovation. Low preference for the A-FO correlated with frequent performance of concentration demanding tasks.

In general, occupants are more satisfied with the general layout and openness of the ABW open-plan offices, however, this might decrease over time as the novelty effect of the new work environment diminishes. The satisfaction rate is also higher for mobile workers who actively switch between workstations on a daily basis compared to workers who prefer to stay in the same work station all the time, however, this might decrease over time as the novelty effect of the new work environment diminishes. The low ratio of workstations to employees in ABW-supportive environments and the competition to occupy a desirable workstation setting might also create dissatisfaction. It is still not clear if the pre-relocation office might affect the level of satisfaction in an ABW-supportive environment. Workers might be more/less dissatisfies when relocating from private offices to an ABW environment, compared to relocating from open-plan offices to an ABW environment.

3.1.2. Indoor Environmental Quality

There are mixed research results for the IEQ of the ABW environments. Three studies (Rolfö, 2018; Rolfö et al., 2018; Candido et al., 2020; Candido et al., 2019) reported positive outcomes, while five studies (De Been and Beijer, 2014; De Been et al., 2015; Lusa et al., 2019; Budie et al., 2019; Gocer et al., 2018) reported negative outcomes.

Several studies reported higher satisfaction for IEQ conditions such as indoor air quality, lighting, and acoustics (Candido et al., 2019), airflow, temperature, amount of light, visual comfort and outdoor view (Rolfö, 2018), satisfaction with auditory privacy (Rolfö et al., 2018), spatial comfort, thermal comfort, noise and privacy, personal control (Ekstrand and Damman, 2016), comfort of furnishing, adjustability of the work area and space to collaborate (Candido et al., 2020). In contrast, five studies (De Been and Beijer, 2014; De Been et al., 2015; Gocer et al., 2018; Lusa et al., 2019; Budie et al., 2019) found negative outcomes related to satisfaction with IEQ in ABW environments.

It is not clear what the reasons are for the conflicting results between studies regarding IEQ in ABW environments as detailed information about the offices has not been reported. It might be related to the quality of building services (i.e., heating and cooling systems, lighting system, acoustic fixtures), however studies such as Candido et al. (2019) showed even if the objective IEQ conditions is similar, occupants in ABW environments rate the environment differently. The ABW occupants can choose the zone to perform their tasks, considering that the number of zones (from low to high energy) should be adequate to cater the occupants’ needs. Higher control levels in ABW environments on where people work might compensate for lack of control over the work environment as a common issue in open-plan offices (which might have caused dissatisfaction with IEQ). Ensuring the number of zones (from low to high energy) are adequate to cater the occupants’ needs, can be achieved and facilitated by modification of the ABW solution after relocation to the new premises, as well as ensuring there is pre-relocation communication between management and occupants about the ABW design. Control issues diminish as the workers are given the option to choose when and where to work from in the post-pandemic world.
3.1.2 Distraction and privacy

There is mixed evidence about ABW’s effect on distraction and privacy. Eight studies examined these aspects in ABW environments, and of these studies three reported positive outcomes (Hoendervanger et al., 2019; Rolfö, 2018; Rolfo et al., 2018), mainly associated with low occupant density and availability of back-up areas in the ABW environments. Five other studies (Barnes et al., 2020; De Been and Beijer, 2014; Haapakangas et al., 2018; De Been et al., 2015) reported negative outcomes regarding concentration and privacy (De Been and Beijer, 2014), visual and auditory privacy (Barnes et al., 2020), decrease in having personal conversations with colleagues (De Been et al., 2015), and privacy and personalization (Haapakangas et al., 2018). One study reported no significant change or no clear positive or negative outcomes (Sugino et al., 2019). Rolfö (2018) also reported that low preference for the A-FO correlated with frequent performance of concentration demanding tasks. One study reported no significant change or no clear positive or negative outcomes (Sugino et al., 2019).

Overall, problems with distraction and privacy were mainly related to the openness and transparency of the ABW environments. These issues are of greater importance for organisations and tasks that require individual focussed work, and also for the employees with an agreeable personality type. There is strong evidence that when ample back-up areas and spaces for private concentration are provided, the privacy and concentration issues are more manageable. However, the role of office layout, interior design, zoning and personality type in relation to distraction and privacy in ABW environments and their association with satisfaction needs more research.

3.1.4 Control over work demand and indoor climate

There was mixed evidence on control outcomes when an organization selects ABW as their way of working. Based on one study (Ekstrand and Damman, 2016), the perception of control over work-related demands is higher when the employees work in an ABW-supportive environment due to the availability of separate work zones. One study (Sugino et al., 2019) suggested that control over the workspace positively affected workers’ ability to cope with distractions and external stimuli.

Regarding control over indoor climate, three studies found employees were concerned about lack of control over indoor climate (Budie et al., 2019; De Been et al., 2015; Gocer et al., 2018). One of these studies (Budie et al., 2019) identified control over indoor climate as one of the variables affecting comfort in an ABW environment when analysing satisfaction and need scores. Gocer et al. (2018) also reported inability to control the indoor air temperature and glare as problematic features of a flexible office with un-assigned workspaces.

Overall, occupants working in ABW environments have a greater control level as they can choose the preferred zone to perform their tasks. As a result, the distraction among mobile workers is decreased. The number of private and teamwork zones should be adequate to cater the occupants’ needs, which can be facilitated by modification of the ABW solution after relocation to the new premises, as well as ensuring there is pre-relocation communication between management and occupants about the ABW design. Although control over the indoor climate is often raised by occupants in surveys as a common problem in ABW-supportive environments, it is also a well-known issue in all open-plan offices. When the occupants have greater control of indoor climate in the ABW environments, satisfaction with IEQ is also likely to increase, however further research is needed to draw conclusions.

3.1.5 Space utilization, activity patterns and workers’ preferences

Nine studies evaluated space utilization, activity patterns and workers’ preferences in workspace designed to support ABW. Six studies (Babapour, 2019; Babapour et al., 2018; Skogland, 2017; Gocer et al., 2018; Hoendervanger et al., 2016; Haapakangas et al., 2018) reported findings about switching behaviours of the occupants (how ABW occupants move between different workstations/zones), three studies investigated activity patterns (Jindo et al., 2020; Babapour et al., 2020; Gocer et al., 2018), and three drew attention to the key measures for reasonable space utilization in ABW and A-FO environments.

Based on four studies, there is evidence that several workers in the offices designed to support ABW do not switch frequently between the workstations (Babapour, 2019; Babapour et al., 2018; Gocer et al., 2018; Skogland, 2017). Babapour et al. (2018) highlighted that the underlying reasons behind the non-appropriation of the desk-sharing policy and space usage were: (1) a misfit with the work needs (i.e., misfits with the participants’ concentrative needs) along with the increased time and effort to switch between work areas, (2) incompatibility with previous ways of working or with individuals’ personal artefacts such as laptops, (3) increased complexity and imposed limitation such as the use of paper documents (4) unclear benefits, (5) complications in set-up. Gocer et al. (2018) and Hoendervanger et al. (2016) showed higher level of satisfaction among mobile workers (workers who switch more frequently among different workstations and zones). Haapakangas et al. (2018) also reported that higher number of workspace switches per day and number of different workspaces used were associated with higher productivity.
Three studies evaluated occupants’ activity patterns in an ABW environment. Babapour et al. (2020) indicated that preference and choices of the occupants to select different workstations include functional, social, emotional, and symbolic aspects of the workspaces as well as their physical structure and stimuli. Gocer et al. (2018) analysed the choices of the work location to be dependent on the desire to have a quiet place to concentrate, daylight, or proximity to colleagues. Jindo et al. (2020) showed that favourite workstations are located close to the central aisle of the office and shared height-adjustable desk workstations near the entrance or window.

Three studies drew special attention to the key measures that lead to reasonable space utilization in offices designed to support ABW and A-FO. Babapour (2019) emphasised the importance of employee participation in the post-relocation process (i.e., by agreed modification of the rules), while Rolfö et al. (2018) highlighted the understanding of the ABW concept among the design and facility management professional communities. Two studies looked at how occupants might change the policies (Babapour et al., 2018) or the use of space as there was a gap between intended and current use of workspaces by employees (Ianeva et al., 2015).

Many workers in offices designed to support ABW do not switch frequently, and this negatively affected satisfaction. One reason might be the gap between the intended and the actual use of the space. Organizations should not only encourage active engagement of the workers in the design and implementation process, but also in relation to redefinition of rules and policies for improved acceptance and satisfaction.

### 3.3.2. Perceived Productivity and work performance

Productivity and work performance are perhaps the most debatable aspects regarding the proposed benefits of ABW environments.

Several studies have found positive associations between productivity and satisfaction with physical environment in ABW offices. Haapakangas et al. (2018) and Hoendervanger et al. (2016) showed increased workspace switching was associated with higher productivity and productivity support. Wadu and Chiang (2019) showed enhanced productivity when social/work interaction increased in an ABW environment, and Divvet et al. (2020) reported greater satisfaction and productivity among team members in an ABW environment. Heck et al. (2012), Shinoyama et al. (2018), Rolfö (2018) and Candido et al. (2019) also reported higher productivity after adaptation of a new ABW/A-FO concept. A further study by Lusa et al. (2019) found that perceived future work ability (productivity) was more positive among those who were satisfied with their workspace than among the dissatisfied respondents. The study respondents were more satisfied with workspace furniture and most dissatisfied with acoustics.

In contrast, De Been and Beijer (2014) reported a strong negative impact of working in flexi offices on satisfaction with the work environment and its contribution to productivity. Wadu and Chiang (2019) also indicated that distraction elements (e.g., interruptions, overcrowding and noise) in an ABW environment had a negative influence on employee performance. In addition, an increase in the time to search for a desired workspace was associated with lower productivity in a study by Haapakangas et al. (2018). Arundell et al. (2018) reported small declines in productivity in workers after relocation to an ABW environment. Haynes et al. (2019) found that the location-fixed workers with less mobility perceived the workplace to have a more negative impact on their productivity than workers with higher mobility. Finally, Pitchforth, et al. (2020) found lower levels of productivity in open-plan and ABW environments compared to zoned open plan and team-focused offices.

Three studies reported mixed negative/positive and neutral results around work performance in ABW workspaces. Negative and neutral impacts on their performance due to visual and acoustics issues (Rolfö, 2018), negative outcomes on quantitative and emotional demands along with neutral outcomes for work pace (Haapakangas et al., 2019), and good level of work ability with no change in perceived performance (Rolfö et al., 2018) was reported by these studies.

Overall, there was no universal agreement on the effects of ABW on productivity and work performance. Lower work performance is associated with increased time and competition to find a preferred workstation for the related task, and with increased noise and other distraction elements. The occupants who rated the ABW environments highly in productivity and work performance highlighted options to use the quiet zone as a positive aspect. It should also be noted that the reported productivity and performance measures were self-reported with no objective measurements.

### 3.3.3. Health

Health is a general outcome term used in this context to characterise the impact of ABW on physical activity, sedentary behaviour, perceived health, well-being, and vitality. Positive and negative relationships between the ABW features and health outcomes have been reported in several studies.
Four studies looked at physical activity and sedentary behaviour in ABW environments. Jindo et al. (2020) observed improvement in physical activity and sedentary behaviour, and Arundell et al. (2018) showed reduced workday sedentary time, and meaningful improvements in moderate-to-vigorous intensity physical activity. Qualitative analysis also suggests that occupants in the ABW workplaces associated ABW solution with greater opportunities for movement while they worked at the workplace. Candido et al. (2019) found that office layout in ABW environments was also found as a near significant predictor of occupants’ light physical activity and sedentary time but did not affect occupants’ daily step counts and distance they travelled. Wahlström et al. (2020) showed that a combination of organizational health culture that promotes health-related activities combined with a facilitating physical environment (i.e., sit-stand desk, walking meetings) can create positive physical activity behaviours.

Candido et al. (2019) reported higher satisfaction with perceived health in ABW environments. A study by Haapakangas et al. (2018) showed a strong positive association between self-rated well-being with the physical environment. In this study, increase in the self-reported time spent searching for a workspace in the ABW environment was associated with lower well-being. These findings are supported by a study by Wohlers et al. (2019), which reported the availability of focussed workspaces was positively related to vitality (as a specific aspect of mental and physical well-being) and job attitude. Luba et al. (2019) indicated that workspace satisfaction was associated with recovery from work strain, a well-being related variable. Pitchforth, et al. (2020) reported that open-plan and ABW offices performed poorly with occupant enjoyment when compared to zoned open-plan and team offices.

Together these studies highlight the probable effects of working in an ABW environment on the improvements in sedentary behaviours and physical activity, but there is not enough evidence that ABW changes occupants’ health related behaviours. Perceived health showed a positive association with ABW environments, but current research evidence is not enough to strongly support this claim.

4. The post-COVID-19 workplace

Following the discussions around “death of the office” in the early stages of working from home arrangements, the “death of ABW” was also discussed. More than a year into the crisis, the ABW solution as a business and human strategy, not only a workplace solution, is becoming more deeply understood. This concept is now realised to be necessary for organizational adaptability in the new and the evolving pandemic situation (Veldoen, 2020). ABW, in its real sense, is now being re-discovered by the organizations and employees while the use of different spaces for different tasks on hand has gained a level of normality quickly. The pandemic crisis has given us an unprecedented opportunity to review and revisit the new ways of working based on lessons learned from the remote working arrangements. Offices seem to be seen as central to socialization, creative collaboration and learning; however new possibilities are being discovered.

When exploring the recent literature (2010-2020), although the outcomes of some ABW variables were more inclined to be either positive (i.e., satisfaction with interior design and social relations), or negative (i.e., IEQ, control, distraction and privacy) outcomes, there seems to be no single aspect which is in full agreement between studies on the effects of ABW environments on occupants. Among the positive aspects, general satisfaction with the physical environment and work control appear to be the most promising, while distraction and privacy are the two aspects with the most negative perceptions. On reflection, the shortcomings of ABW environments appear to be more related to how this new way of working is implemented and how people use it, not the concept itself. A partial uptake of this concept leads to greater occupant dissatisfaction, lower productivity and lower well-being, while a holistic approach increases the likelihood of success. Attention should be given to the three key components of open-plan offices designed to support ABW: physical environment, human and organization specifically in the context of the post-COVID workplace.

Regarding organizational aspects, acceptance and adoption of the ABW mindset by managerial roles in an organisation which might have eased by undesirable move to remote and flexible working during the COVID_19 pandemic is a pivotal aspect. Experience from the pre-pandemic office workspaces showed us that each aspect of organisational policy making should be contributed to by the workers and tailored to the organization’s culture. The issues that need careful planning and regular input from the workers include the percentage of the workers who work at the office at any one time, how communications should be operationalised within and between teams, when and where employees work.

From the human perspective, flexibility and mobility give every worker a range of options to choose from. The stress experienced by introverts in adapting to ABW might reduce if they are provided the options to work mainly from their desired environment. Given that workers should be encouraged to actively contribute to creating policies for the new ways of working during and after the pandemic, coming to a solution which caters for all workers and considering individual differences is important.
Regarding the physical environment, several known problems of the pre-COVID workspaces designed to support ABW, can be resolved through new work arrangements. Issues such as distraction, privacy, lack of control over the work environment and lower health, productivity and satisfaction associated might be minimised as operating in an ABW workplace is adapted with support of technology. Being able to switch between several spaces/environments including home, office, co-working spaces or even café or local library could be a viable solution to these issues as future work arrangements evolve. In contrast, the new work arrangements might not work well for factors that are not in the control of workers. Issues such as lack or ergonomic furniture can be resolved by organization providing the necessary equipment, while amount of daylight and quality of the HVAC (heating/cooling, ventilation and air conditioning) at their home office is not easy to address. Despite of challenges associated with remote working, experience has shown us that people strive for the flexibility and autonomy that remote working gives them. Removing this flexibility might push the workers to leave the organizations as the talent war may not rely on high-end offices anymore, but on the flexibility and autonomy given to the workers.

Among the possible scenarios for the future of ABW is the idea of a network of spaces including office, home, or any other spaces such as a local café or a library. People have the option to move around based on their preferences and activities at hand. The idea of a central office headquarters seems necessary as the pandemic has clearly accentuated the necessity of having a physical workspace for specific collaborative tasks. These emerging work arrangements can be considered a new version of ABW, however there is still no clear evidence where this idea will land. Whatever the short, mid, and long-term solution to evolving workplaces post COVID-19 will be, the way we work and live might have changed forever. Despite the predictions of the future workspaces post-pandemic, none can give us an accurate picture due to the evolving nature of this global event.

Conclusion
This systemised review has mapped and described organizational, human and environmental-related aspects of workspaces designed to support ABW based on academic research produced over the last ten years (2010-2020). The key topics of investigation emerging from the literature are discussed along with the positive and negative aspects of ABW-supportive environments documented in the research studies that can be used to inform post-COVID workplaces.

Although the literature search for this paper was conducted amid the COVID-19 pandemic, to date there has been no research related to the effects of COVID-19 pandemic on ABW. This is expected considering the unpredicted global situation, the period needed to conduct the research and the long process of peer review in academic publication.

The 36-40 papers discussed in this review had significant differences in study design, sample size, and quality of the analysis, hence limiting the chance of drawing solid conclusions. The fact that almost all studies have focused on case studies, with the majority evaluating medium sized offices, adds to this limitation. It should also be noted that very limited information on the interior design and layout of these office case studies was available which makes it even more difficult to identify strong associations or possible cause-and-effect relationships between specific features of ABW environments and occupants’ satisfaction, productivity and well-being. Studies that have conducted a pre- and post-relocation studies may suffer more from this limitation as no detailed information is available about the pre-relocation office layout.

A strong inter-connection between the three ABW pillars (organizational, human and physical environment aspects) seems to dictate the success of an open-plan office designed to support ABW: physical environment, human and organization. Various challenges and shortcomings were reported by the included studies regarding these three aspects in ABW environments. Lack of opportunity to modify the workspace, complex IT facilities, lack of cleanliness and storage, decrease in productivity specifically for immobile workers, lack of control over the work environment, increased distraction and lack of privacy are among the challenges reported in these studies. In relation to the organizational aspect, identified challenges included unclear rules and policies, lack of support for IT facilities, a weak management system, and a lack of communication between the employees and the organization.

Amid the pandemic, the mindset of ABW seems to be already adopted and implemented although many organizations and workers do not know it by this name. Many of the negative aspects related to the human and physical environment in the current body of literature in relation to ABW concept might diminish as ABW evolves into its new shape. Having control over the work environment, satisfaction with IEQ, privacy, being able to complete focused work, and higher productivity rates have already been reported in recent studies on work from home arrangements. New challenges are arising from this new work arrangement such as difficulty in communication and mental health issues, which might be more manageable as an interconnection between the three mentioned pillars of ABW concept.
Practical implications and suggestions for future research

Findings of this research can advance the understanding of the effect of ABW mindset and ABW-supportive environments on occupants and organizations. It will benefit workers, built environment and organizations by gathering the findings of evidence-based academic research around ABW-supportive environments. This study specifically helps the organizations who have already applied ABW to re-think and re-design their policies and physical configurations of the workplace. Furthermore, it helps the organization that are planning to provide an ABW-supportive environment for their employees to be familiar with positives and negatives of ABW, and make an informed decision and minimize the probability of failure.

This study has only considered subjective studies in real ABW-supportive environments. Future literature reviews can focus on objective measurements, simulations, and lab experiments in these environments.

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References


