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REVIEW ARTICLE

Methods and approaches for evaluating occupant satisfaction with office space design: a systematic review

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ABSTRACT

Occupant satisfaction in office spaces is a critical factor influencing occupant's productivity, satisfaction and overall workplace experience. This systematic review examines the methodologies and approaches used to assess occupant satisfaction with office space design, identifying key evaluation tools and research trends. The study explores the extent to which existing methodologies integrate environmental, spatial and design factors to provide a comprehensive understanding of user experience. Additionally, it highlights the limitations in current assessment tools, including the lack of standardised frameworks for capturing occupant feedback at different stages of the design process. The findings suggest a growing shift towards data-driven and real-time feedback mechanisms to enhance workplace adaptability. By synthesising existing research, this review aims to provide insights for designers, facility managers and policymakers to refine evaluation methods and integrate occupant-centric strategies into office space planning.

Practitioner Summary: This review explores assessment methods for occupant satisfaction with office design, finding a stronger focus on building physics (e.g. environmental comfort) over aesthetics. It highlights survey tool trends and a lack of design-focused methodologies, suggesting unified approaches to improve office design and satisfaction evaluations.

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Occupant satisfaction assessment; User-centered office design; Workplace experience; office environment evaluation

1. Introduction

Research on the impact of office spaces on occupants has been a subject of investigation since the 1980s (Vischer and Wifi 2017). However, the COVID-19 pandemic transformed traditional workplaces, sparking renewed interest both in academia and in the industry in how office environments influence satisfaction, health and productivity (Helmold XXXX). Because of the pandemic, companies have started to adapt to different models of work, from home working to flexible working (Al-Habaibeh et al. 2021), thereby encouraging independence, autonomy and trust in the workforce (Helmold XXXX). Home-office and remote working are now constitutive parts of a 'new normal' (Carroll and Conboy 2020). Employees now acknowledge strong benefits in remote working, such as reduction in commuting time and flexible hours. Consequently, several organisations recognise that lack of work flexibility may lead to a loss of talents (Marzban et al. 2023). Organisations have started to re-consider the purpose of the physical workspace (Marzban et al. 2023). First, by designing an office space that allows for social distancing (Carroll and Conboy 2020). Second, by re-evaluating the space layout to reflect the reduced on-site workforce, addressing underutilised areas and optimising the overall office space requirements (Carroll and Conboy 2020). For instance, new office space layout offer flexibility in the choice of type and location of work (Sirola et al. 2022). In addition, companies have been adopting new workspace design concepts that include more 'playful and innovative' surroundings (Poupard, Mateev, and Mantelet 2019), to increase employee retention and attract new talent. As a result, the importance of providing workspaces that meet employee expectations is gaining significant attention from employers, office space developers and employees themselves (Kamarulzaman et al. 2011).

The office environment is important to employee's satisfaction for several reasons, such as health and well-being (Kamarulzaman et al. 2011; Haapakangas et al. 2018; Abeyrathna et al. 2024), comfort and engagement (Rasheed, Khoshbakht, and Baird 2019)

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productivity and better work outputs (Dole and Schroeder 2001). In fact, the term 'satisfaction' with the office space has been considered from different perspectives. Previous scholars have broadly defined satisfaction as the fulfilment of expectations related to objects, services or experiences (Lassen and Goia 2021). Employee satisfaction has been defined as the degree to which the office environment aligns with and meets employees' needs and expectations, focusing on the role of the physical working environment (Van Der Voordt 2004). Despite this broader definition, much of the research on occupant satisfaction in office spaces has predominantly focused on measuring environmental comfort, encompassing aspects of building physics such as thermal conditions, lighting, acoustics and air quality (Tiara and Gamal 2021) where the design and interior elements of the space are often overlooked (Paul and Taylor 2008). The emphasis lies on 'physical comfort' or 'environmental satisfaction with working conditions' (Kwon and Remøy 2019) with limited attention paid to the value or the spatial design (Agha-Hossein et al. 2013), such as aesthetics (Ong 2013), or office furniture, layout and spatial characteristics which are also are poorly considered (Scrima et al. 2021).

While previous literature reviews have extensively examined individual factors influencing employee satisfaction in office spaces – such as air quality (Gupta et al. XXXX), activity-based workplaces (Masoudinejad and Veitch 2023) and indoor environmental quality (Heinzerling et al. 2013), they have often done so in isolation.

These studies primarily focus on specific physical or environmental attributes, such as thermal comfort, workspace flexibility and green building features, without a comprehensive integration of all contributing elements. However, employee satisfaction is a multifaceted outcome (Nairobi XXXX) shaped by the dynamic interplay between spatial design, environmental conditions and workplace policies.

This fragmented approach presents a challenge for design practice, where decisions must account for the holistic experience of occupants rather than isolated environmental factors (Haapakangas et al. 2025). The lack of integrated knowledge on the drivers of employee satisfaction not only limits a comprehensive understanding of user needs but also hinders the ability of architects, interior designers and facility managers to create truly user-centred workspaces. Without this integration, design interventions risk being reactive – addressing singular issues like air quality or noise reduction, rather than proactively shaping environments that support occupant's satisfaction (Carthey 2006; Kim and de Dear 2013).

To address these gaps, this article aims to conduct a systematic literature review to evaluate the methodologies and metrics used in previous studies to capture occupant satisfaction with office space design. More specifically, this review seeks to answer the following research question and sub-questions:

How is occupant satisfaction with office space design evaluated by previous work?

a. In what context, is occupant satisfaction with office space design studied?
b. What methodologies are commonly used to assess occupant satisfaction with office space design?
c. What domains are considered to evaluate satisfaction with office space design?
d. When in the design process, are these methodologies applied?

The ultimate objective of this review is to map the current research landscape and identify future directions that can support office space designers in developing evidence-based frameworks for improving occupant experience. By consolidating knowledge across multiple domains, this study seeks to provide designers, facility managers and researchers with a clearer understanding of how occupant satisfaction data can be systematically integrated into the design process, leading to more adaptable, user-centred office environments that align with evolving workplace needs.

2. Methodology

For this review, literature was gathered and categorised following the PRISMA model for systematic reviews (Page et al. 2021). The search primarily targeted two databases: Scopus and Web of Science, supplemented by additional records. The focus was on journal articles presenting empirical studies spanning the fields of engineering, psychology and social sciences. Exclusions were applied to unpublished works, theses, conference proceedings, book chapters, non-scientific articles and articles in languages other than English (Figure 1).

The literature search was conducted in April 2024 utilising a search string combining keywords (see Table 1) related to employees, users, occupants and various aspects of office design and satisfaction.

The search across the three sources yielded 186 literature findings. After removing 49 duplicates, the remaining abstracts underwent screening. Of these, 50 articles were excluded for various reasons, such as not being journal articles, lacking relevance to office design or occupant satisfaction, or due to limited

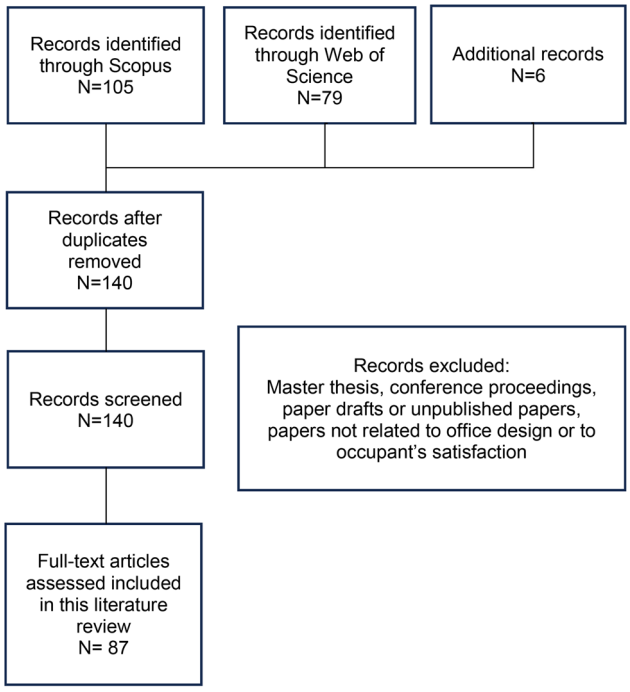


Figure 1. It shows the steps of literature exclusion taken. The process started with 187 literature pieces that were screened for duplicates, type of article and research setting. A total of 87 literature pieces were elected for further investigation.

Table 1. Combination of search keywords for this literature review.

	Keyword 1		Keyword 2		Keyword 3
OR	Employee	AND	Office design	AND	Satisfaction
	User		Office architecture		
	Occupant		Office layout		
			Workplace design		
			Workplace architecture		
			Workplace layout		
			Workspace design		
			Workspace architecture		
			Workspace layout		

Specifically, the search string used the combinations 'employee OR user OR occupant' AND 'office design OR office architecture OR office layout' OR 'workspace design OR workspace architecture OR workspace layout' OR 'workplace design OR workplace architecture OR workspace layout' AND 'satisfaction'.

Alt Text T1: A table listing various keyword combinations used in the literature review search string.

access to the full article. Ultimately, 87 records were deemed suitable for inclusion in this review.

3. Overview of review results

Figure 2 shows the annual publication trends in the field, revealing a notable increase in articles addressing occupant satisfaction within office settings over time with a consistent rise in publications observed from the late 2000s onwards, particularly surging in 2013, 2016 and peaking in 2019. The earliest study found dates to 1981 (Schuler et al. 1981).

As of June 2024, a total of 2 publications were recorded. Remarkably, the publication rate exhibits a sharp growth during years coinciding with the peak of the COVID-19 pandemic. This period is characterised by a significant shift from traditional on-site work to remote setups, prompting companies to navigate challenges in maintaining employee motivation and connectivity outside the physical office environment. With the workforce predominantly operating from home for extended periods, the pandemic shifted life and work patterns, transforming the space for collaboration and communication (key aspects to innovation) from a physical office to a digital space (Al-Habaibeh et al. 2021).

Figure 3(b) shows that most research took place in The United States ($n=15$), and in multiple settings ($n=9$), meaning that the same research publication considered offices in different countries, followed by Australia ($n=9$). In Europe, most publications have been done in The United Kingdom ($n=7$) followed by the Netherlands ($n=6$).

In terms of continent, most of the research was in Europe (36%) followed by America (24%), Asia (18%) and Oceania (11%). A 10% of the research took place in 'multiple settings'. Although countries like Germany have the most population in Europe (81.4 million inhabitants) and the white-collar workforce builds almost 20% of the population (Hammermann and Voigtländer 2020), only one research found within this review took place in Germany (Herbig, Schneider, and Nowak 2016).

A wide range of sample size is present in current literature. Overall, the sample sizes within the research projects found within this literature review vary from 12 participants (Luna-Navarro and Overend 2021) to more than 60,000 (from existing data base of Centre of the Built Environment) (Parkinson et al. 2023). Moreover, out of ninety-two pieces of literature found, approximately half of these studies (47) specify the gender proportion of participants in their results. The remaining studies did not specify this information.

Although individual studies exhibit significant gender disparities, the aggregated data across all studies indicate a balanced representation, with females comprising 52% and males 47% of the total sample. The remaining participants are categorised as 'diverse' or 'prefer not to answer.'

The composition of study participants appears to be strongly influenced by sector demographics, as evidenced by Forooraghi et al. (2023), who found a higher proportion of women in public sector studies (Forooraghi et al. 2023) and Morrison and Smollan

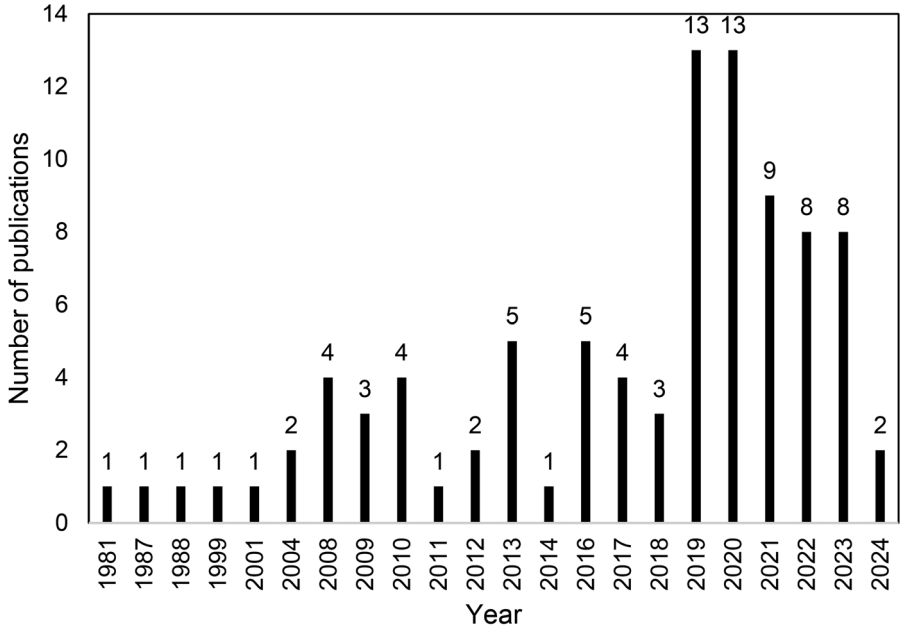


Figure 2. It shows the number of publications per year from 1981 to 2024 found within this literature review. The graph also shows a high peak on the amount of research done during the pandemic (2019) with tendency towards more publications ever since.

(2020), whose research in a female-dominated law firm reflected this imbalance (Morrison and Smollan 2020). Conversely, studies examining office layouts and autonomy often have male-skewed samples, such as Davis, Leach, and Clegg (2020), where 82.5% of the 406 participants were male (Davis, Leach, and Clegg 2020), or research on knowledge exchange in a production-focused company, where 96% of the 138 participants were male, yet this demographic imbalance was not acknowledged as a study limitation (Appel-Meulenbroek, de Vries, and Weggeman 2017). These findings suggest that gender representation in workplace studies is frequently shaped by sector-specific workforce composition, but disparities in male-dominated environments may be overlooked, potentially biasing conclusions. Figure 4 shows that most studies ($n = 53$) were conducted in corporate offices, indicating that this setting has been the primary focus of workplace research, followed by academic offices ($n = 8$) and administrative offices ($n = 7$). The prevalence of corporate office studies may be attributed to private sector funding and a historical emphasis on occupant satisfaction in controlled indoor environments.

4. Methodologies used in previous work

Occupant satisfaction in the office space has been investigated with different methodologies. Figure 5 shows the main methodologies that have been used by previous scholar to evaluate occupant satisfaction with the office space. First, Quantitative methods where research included numerical data analysis from questionnaires, counting, polls or sensors, followed by Qualitative methods like analysis of interviews, texts, videos or audio to understand experiences or opinions. And lastly Mixed methods where a mix of both quantitative and qualitative analysis is applied to get a broader understanding of occupant's satisfaction in the office space.

Most articles (65.5%, $n = 57$) used quantitative methods, while 32.2% ($n = 28$) used mixed methods and only 2.29% ($n = 2$) used mere qualitative research methods. The following subsection analyse each of these classes.

4.1. Quantitative methods

Figure 5(a) illustrates that most of the literature findings (57 out of 87 or 65.5%) relied solely on quantitative research methods to evaluate occupants' satisfaction with office spaces. Among these methods, questionnaires were the most used ($n = 35$), followed by studies utilising data from previous questionnaire campaigns ($n = 8$).

Notably, the same portion of studies ($n = 8$), combined questionnaires with environmental quality measurements, such as acoustics, lighting, temperature and air quality.

An emerging trend involves physiological data collection using wearable sensors to complement self-

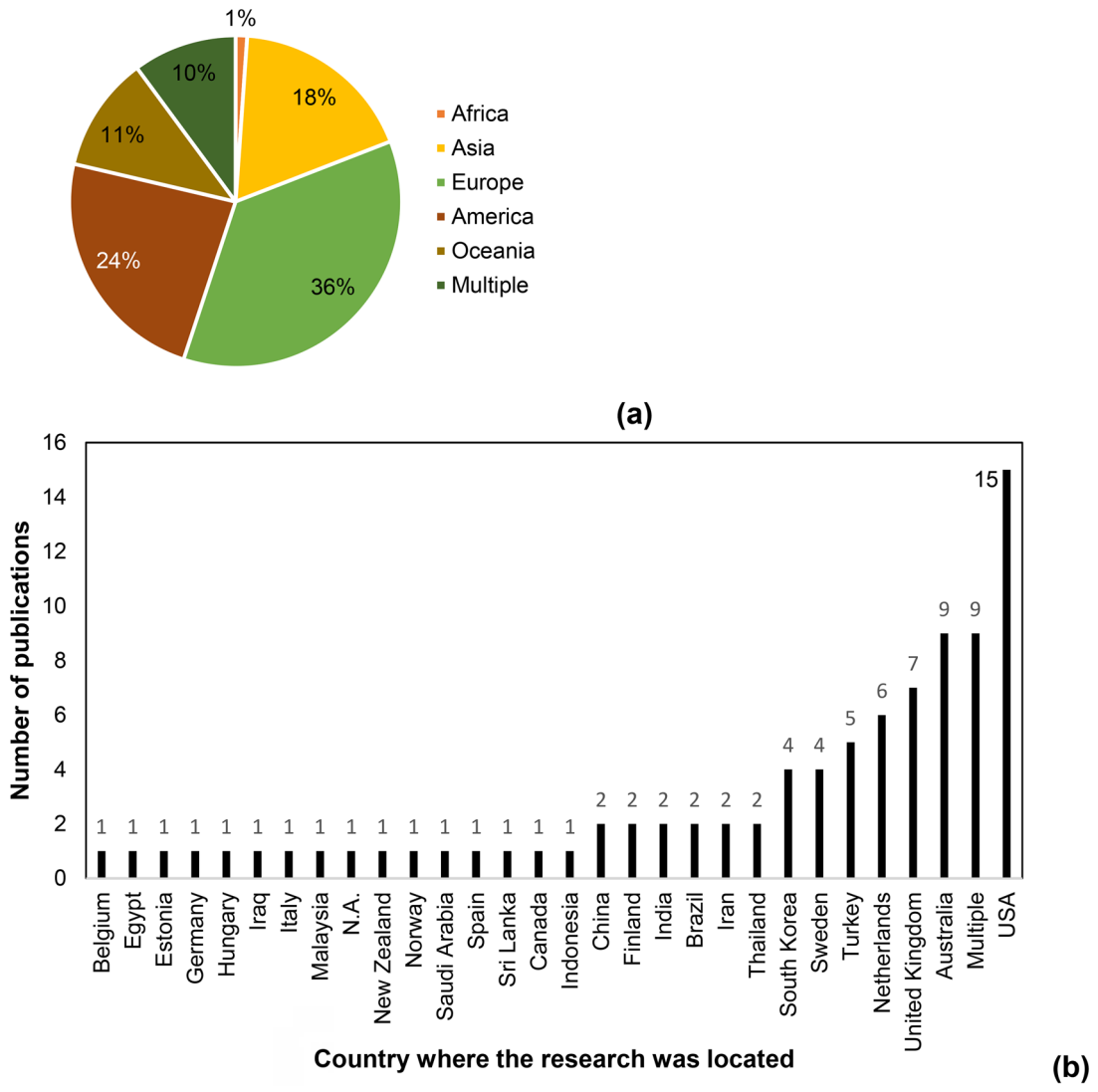


Figure 3. (a) And (b) show number of publications per country and continent of research setting. The data extracted was categorised according to the country (Figure 3(a)) and continent (Figure 3(b)) where research took place.

reported satisfaction measures. For example, Aristizabal et al. investigated the impact of biophilic elements in the workspace on occupant satisfaction and employee stress levels. Their study utilised wrist sensors in a controlled lab environment, revealing that biophilia significantly reduces stress among employees. Participants additionally completed daily questionnaires to complement the sensor data (Aristizabal et al. 2021). In a similar fashion, Candido et al. (2019) used smartwatches to measure stress levels while studying the influence of activity-based workspace designs on satisfaction, productivity and physical activity (Candido et al. 2019) which underlines a slight tendency on the use of wearables to better understand the experience of users in office spaces.

4.1.1. Meta-analysis from existing data from previous questionnaires

After questionnaires, the second most used method for quantitative data collection, is referring to secondary data from existing questionnaires ($n=8$) (see Figure 5(b)).

Meta-analysis from already published survey results can be very effective since enables to access larger amount of data, for instance allowing to answer research questions that required large datasets (Candido et al. 2016) or cross-comparison between multiple buildings (Bourikas et al. 2021), thereby strengthening the conclusion and generalising the results by reducing the influence of specific contexts (Goins, Jellema, and Zhang 2010) or methods (Kim et al. 2013).

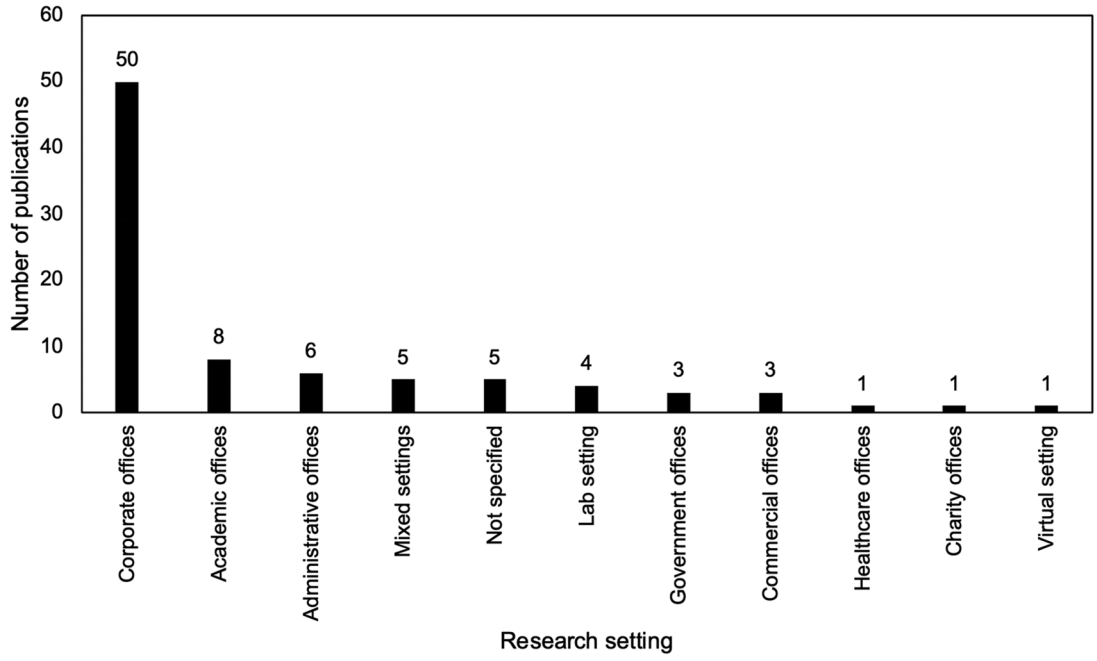


Figure 4. Number of publications from 1981 to 2024 categorised by the type of office setting where the research study was made showing a clear difference between a corporate office setting and all other office settings.

The literature shows that the five most used data bases for the meta-analyses are:

i. The Occupant Indoor Environmental Quality Survey from the Centre of the Built Environment (CBE) at the UC Berkeley, which was used by 15 different research articles, and collected data from more than 600 buildings, mainly in the US but also in different countries.
ii. The Building User Survey (BUS) currently owned by Arup in the United Kingdom, which until 2019 had collected more than 5000 samples across 61 buildings (Rasheed, Khoshbakht, and Baird 2019);
iii. The Building Occupant Survey System Australia (BOSSA) developed by The University of Sydney and the University of Technology, Sydney and which is commonly used as the National Australian Built Environment Rating System (Göçer et al. 2019; Kim et al. 2016);
iv. Leesman's database that includes samples of 82,315 respondents (Radun and Hongisto 2023);
v. The OFFICAIR survey project, which included data on 7441 occupants in 167 office buildings across Europe (Sakellaris et al. 2019).

Additionally, one study found on the impact of socialising in the workspace on wellbeing, used existing data from two post-occupancy evaluations made in the Dutch public sector (Colenberg et al. 2021) and two literature results did not specify the database used (Langston, Song, and Purdey 2008; Schwede, Davies, and Purdey 2008).

4.2. Qualitative methods and mixed-methods

Although qualitative methods provide valuable insights into how occupants reflect on past experiences and adapt to office environments over time, their use remains limited in workplace research. These methods are particularly effective in capturing perceptions of comfort, productivity and well-being (Babapour 2019) and in exploring individual, organisational and spatial adaptations to flexible office designs (Langston, Song, and Purdey 2008). However, despite their potential to deepen understanding of workplace dynamics, only two studies exclusively employed qualitative methodologies (Forooraghi et al. 2023; Heidmets, Durmanov, and Liik 2019). This underutilisation suggests a methodological gap, as qualitative research could offer richer contextual interpretations that complement traditional quantitative assessments (Schwede, Davies, and Purdey 2008; Heidmets, Durmanov, and Liik 2019; Graham, Parkinson, and Schiavon 2021).

As also shown in Figure 5, 20 research articles utilised mixed methods to assess occupant satisfaction with office spaces, accounting for nearly 20% of the total reviewed literature. Most researchers in this category combined questionnaires and interviews.

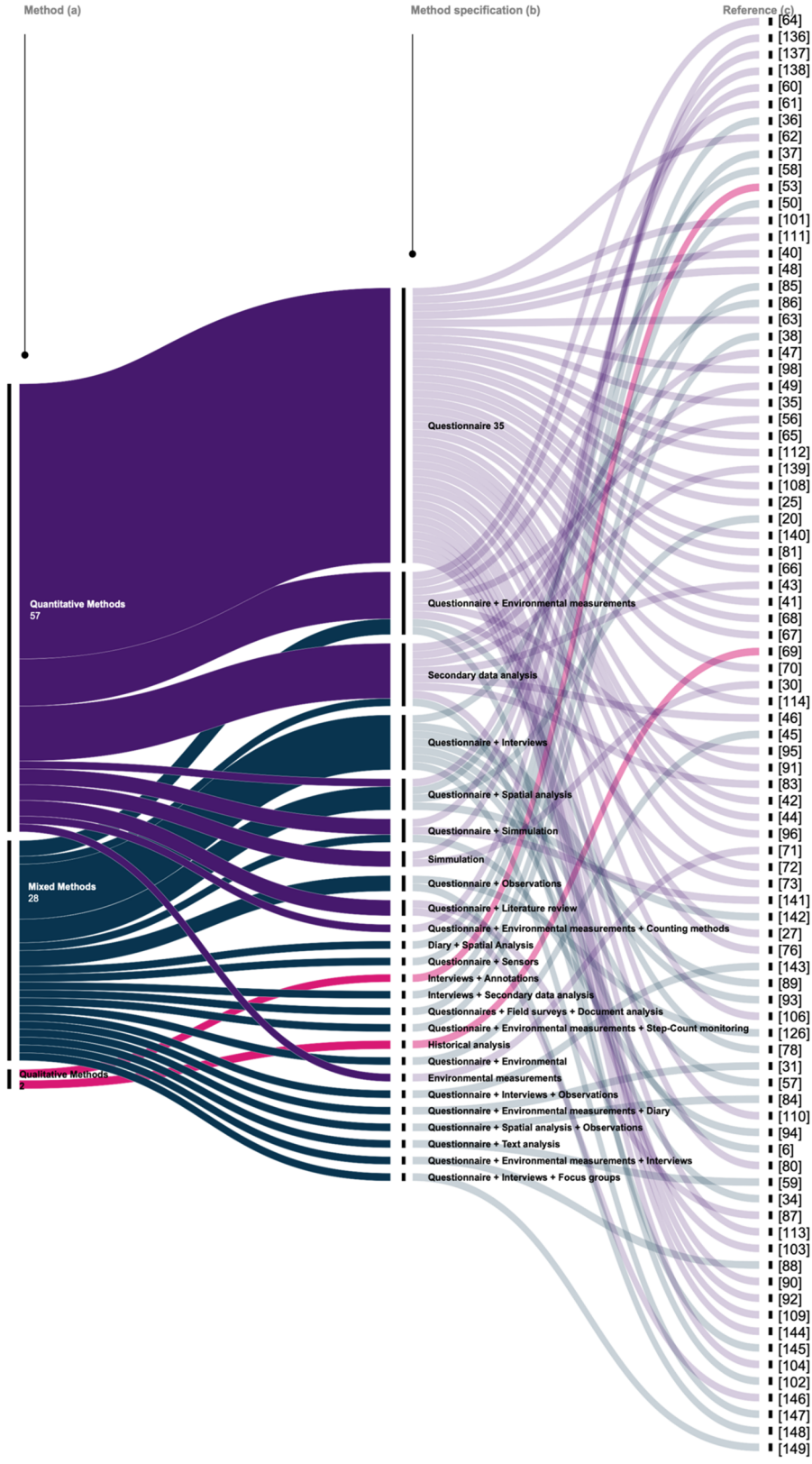


Figure 5. Overview of methods used in studies on occupant satisfaction with office design. (a) Proportion of research methods: quantitative ($n = 57$), mixed ($n = 28$) and qualitative ($n = 2$); (b) Tools used: Quantitative studies primarily used questionnaires ($n = 35$).

Table 2. Overview of tools for assessing occupant satisfaction with office spaces, including their validity (marked 'V').

Validity	Type of survey tool	Number of references	Scale	Reference
29/51 validated (V) or partly validated (partly V)	Bespoke	51	Several	Ali Mustafa and Abdullah Azeez (2022); Aminuddin, Rao, and Hong (2012); Appel-Meulenbroek et al. (2022) (V); Aristizabal et al. (2021) (V); Chatterjee et al. (2022) (V); Davis, Leach, and Clegg (2020) (V); de Vries et al. (2018) (V); Dianat et al. (2013) (V); Dinç (2009) (V); Giddings and Ladinski (2016) (V); Oldham (1987, 1988); Haapakangas et al. (2019) (V); Heidmets, Durmanov, and Liik (2019) (V); Herbig, Schneider, and Nowak (2016) (V); Kasuganti (2018); Kaushik et al. (2020) (partly V); Khanna and New (2008) (partly V); Kim et al. (2020) (V); Kim, Cho, and Hong (2023); Knight and Haslam (2010) (V); Labib, Nabil, and Amin (2023) (V); Luna-Navarro and Overend (2021); Lei et al. (2022); May et al. (2004) (partly V); Morrison and Smollan (2020); Morrow, McElroy, and Scheibe (2012) (V); Permana, Nurrahman, and Permana (2021); Pathak, Dongre, and Shiwalkar (2014); Najjar, Akkad, and Almahdaly (2023); Ozdemir (20100; Parkin et al. (2011); Rashid, Wineman, and Zimring (2009) (V); Rolfö (2018); Riratanaphong and Chaiprasien (2020); Riratanaphong and Narmwiset (2023) (V); Schuler et al. (1981) (V); Scrima et al. (2021) (V); Shahzad et al. (2017) (V); Sirola et al. (2022) (V); Taskin, Parmentier, and Stinglhamber (2019) (V), Tiara and Gamal (2021); Veitch et al. (2013) (V); Ornstein et al. (XXXXa); Windlinger et al. (2016) (V); Wong et al. (2023); Woo et al. (2021); Yildirim et al. (2020); Zerella, von Treuer, and Albrecht (2017); Zhuang et al. (2022)
V	Centre of the Built Environment (CBE)	9	Likert 7	Goins, Jellema, and Zhang (2010); Kim et al. (2013); Kim and de Dear (2013); Lassen et al. (2020); Graham, Parkinson, and Schiavon (2021); Parkinson et al. (2023); Sediso and Lee (2016); Lee and Guerin (2010); Lee and Kim (2008)
V	Building User Survey (BUS)	6	Likert 7	Bourikas et al. (2021); Menadue, Soebarto, and Williamson (2013); Rasheed, Khoshbakht, and Baird (2019); Rasheed et al. (2021); Thomas (2017); Brown et al. (2010)
N.S.	Not specified	4	n.s.	Colenberg et al. (2021); Indriyati (2018); Langston, Song, and Purdey (2008); Schwede, Davies, and Purdey (2008)
V	The Building Occupants Survey System Australia (BOSSA)	3	Likert 7	Candido et al. (2019); Göçer et al. (2019); Kim et al. (2016)
V	SATURNO	1	n.s.	Ornstein et al. (XXXXb)
V	Rolfö (2018)	1	Likert 7	Forooraghi et al. (2023)
V	Gensler	1	n.s.	Ma and Cha (2021)
V	The Comfort Survey	1	Likert 6	Borsos et al. (2021)
V	Reactions to the Physical Work Environment Scale (RPWES)	1	Likert 5	Libby et al. (2019)
V	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	1	Likert 7	Bae, Asojo, and Martin (2020)
V	Employee Satisfaction Evaluation (ESE)	1	Likert 5	Abeyrathna et al. (2024)
V	OFFICAIR Project Survey	1	Likert 7	Sakellaris et al. (2019)
V	Igroup Presence Questionnaire (IPQ)	1	Likert 7	Hong et al. (2019)
V	Leesmann	1	Likert 5	Radun and Hongisto (2023)

Bespoke tools are the most common (51 publications), followed by the Centre for the Built Environment's survey (6 publications). Four studies did not specify (n.s) a survey tool, and most tools use 7-point scales.

Alt Text T2: A table summarising tools used to assess occupant satisfaction with office spaces. It includes details on validation status (marked 'V'), the prevalence of bespoke tools (51 publications), the Centre for the Built Environment survey (6 publications) and unspecified tools (4 studies). It also highlights the common use of 7-point scales in these assessments.

Several scholars reported that the use of mixed methodologies lead to deeper understanding of the drivers of occupant's satisfaction with the office space (Graham, Parkinson, and Schiavon 2021; D'oca et al. 2016).

Similarly, a study by Dianat et al. focus on lighting measurements to improve staff and employee satisfaction and only used subjective reports. The authors mention that this is a limitation and that further research including objective environmental measurements would be advisable to strengthen conclusions (Dianat et al. 2013).

Additionally, research by Rolfö found that using a mixed-methodology approach leads to more meaningful insights into the factors affecting office environments, measures the impact of interventions and cross-validates results (Rolfö 2018). Similarly, a study by Forooraghi et al. emphasised the value of mixed methods for obtaining a comprehensive understanding of how office design influences occupant satisfaction (Forooraghi et al. 2023). Also, Permana, Nurrahman, and Permana reported that combining qualitative and quantitative data enhances research reliability (Permana, Nurrahman, and Permana 2021).

Pathak, Dongre, and Shiwalkar demonstrated the benefits of qualitative inputs for understanding occupants' perceptions, while quantitative data provided evidence of actual environmental conditions (Pathak, Dongre, and Shiwalkar 2014). In agreement, Sirola et al. (2022) pointed out that the use of both qualitative and quantitative methods offers deeper insights into occupant responses. Their study also involved workspace consultants who used participative qualitative methods, such as workshops, to engage occupants in the office design change process, although these methods were not included in the research.

As pointed out, there are several benefits on the use of mixed methodologies and, no significant limitations were identified regarding mixed methodologies, apart from the fact that they can be more time-consuming than purely quantitative approaches.

4.3. Type of questionnaires, domains, items and scales

The literature evidence reveals that there are more than 60 different questionnaires used for assessing occupant satisfaction with office space (Table 2).

A total of 51 studies used bespoke questionnaires which emerges as the preferred choice among scholars.

However, the use of different survey tools means there an absence of standardised tools capable of comprehensively capturing the multi-domain spectrum of occupant satisfaction with workspace design (Kim et al. 2013; Borsos et al. 2021).

As Table 2 shows 39% of scholars have opted to use a 7-point Likert-Scale to measure occupant satisfaction in the office. In second place, the 5-Point Likert-Scale has been the preferred one. Only a small number of authors have chosen scales with pair numbers.

For example, in a study by Chatterjee et al. (2022) that focused on the impact on satisfaction of COVID 19 to Front-Line Employees, a 5-point scale was chosen to give the option to participants to opt for a neutral value by not disagreeing nor agreeing. Contrary to the research by Woo et al. were a IEQ assessment was deployed in 7 buildings showing a discrepancy between subjective and objective information collected, which used a six-point Likert scale to 'force' or oblige participants to give a value for their response by taking away the possibility of choosing a middle number or a neutral value (Woo et al. 2021).

The choice of scale and its values seems to be a matter of preference of the authors and has not been mentioned as a limitation in any of the studies referenced within this literature review.

Table 2 also shows that the question to measure occupant satisfaction with the office space remains congruent by all questionnaires: 'How satisfied you are you with [domain/item]?' and the scale description usually vary from: 'very dissatisfied-very satisfied/fully satisfied' to 'completely disagree completely agree'.

Interestingly, the survey tool of Igroup Presence Questionnaire (IPQ) used on the research by Hong et al. asks about satisfaction with the question: 'Are you satisfied with the [item]?' but the Likert scale varies from strongly disagree to strongly agree. The research article does not specify if this incongruency in the terminology of both the question and the response option was a limitation (Hong et al. 2019).

Also, only one article by Yildrim et al. which studied window proximity regarding occupant satisfaction included a semantic differential scale that measures occupants' perception of the office space in form of opposite statements and the results show that the distance to windows directly affected the satisfaction of call-centre employees (Yildirim et al. 2020). Using alternative scales could be a subject for further research.

Table 2 shows the diverse types of tools to retrieve information on occupant satisfaction with the office space. The table reveals information on the validity (partly or complete) of the tools used and it is marked with a letter 'V' after the reference. Partly validated surveys mean that some of the questions and/or scales were validated but not the whole questionnaire. A total of 51 publications have used bespoke* tools. The second most used tool is the Centre of the Built Environment's survey with 6 publications. In four publications, there was no survey tool specified. Most tools use 7-point scales.

For the analysis of the 9 validated questionnaire tools, the following terms will be used: (i) Domain: the overarching subject that is studied in a questionnaire tool, such as environmental comfort; (ii) item: a specific factor that is investigated within a domain, e.g. thermal comfort, satisfaction with daylight, etc.

The tool covering the most items ($n=41$) is 'The Comfort Survey,' developed as part of a study by Borsos et al. (see Figure 6). This survey is part of a tool to help occupants identify zones of discomfort within office spaces. It highlights aspects not considered by other survey tools, such as amenities like parking spaces, quiet rooms, kitchens, lounges, gyms and sports facilities, which seem to impact occupant satisfaction, alongside a primary emphasis on environmental comfort. This tool focuses on understanding the occupant's day in terms of tasks, types of offices and amount of movement and/or sedentary work in a regular working day and retrieves information on the

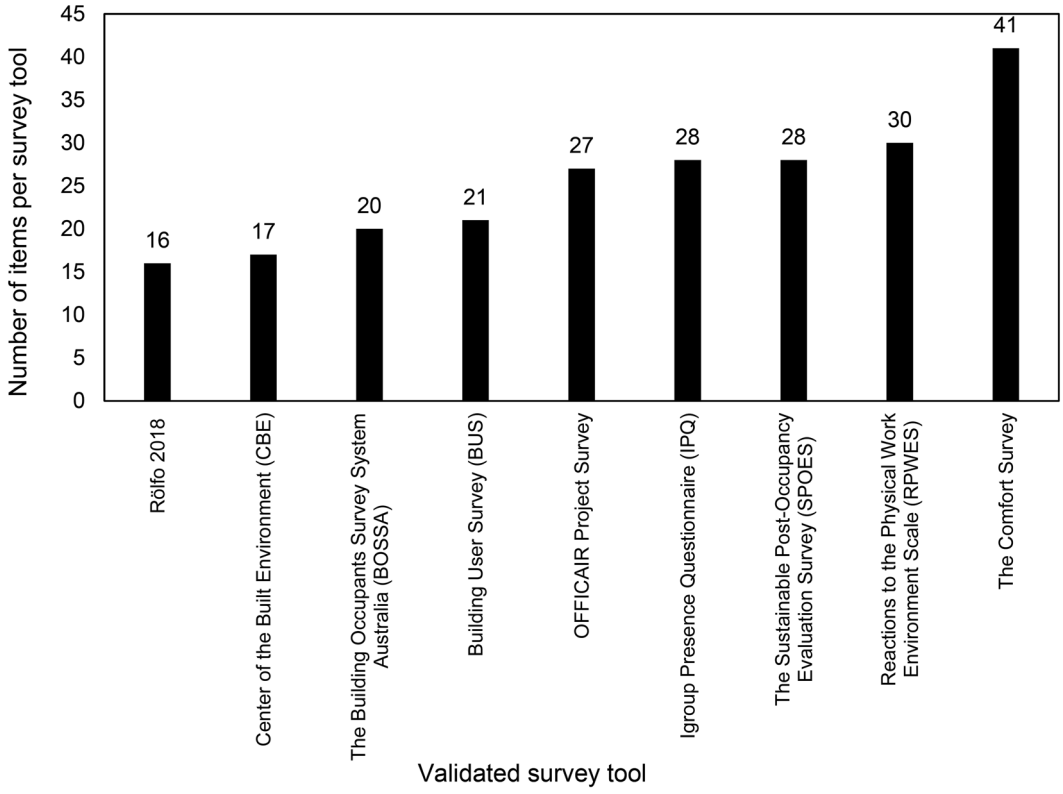


Figure 6. Overview of the item count in 9 validated surveys reviewed.

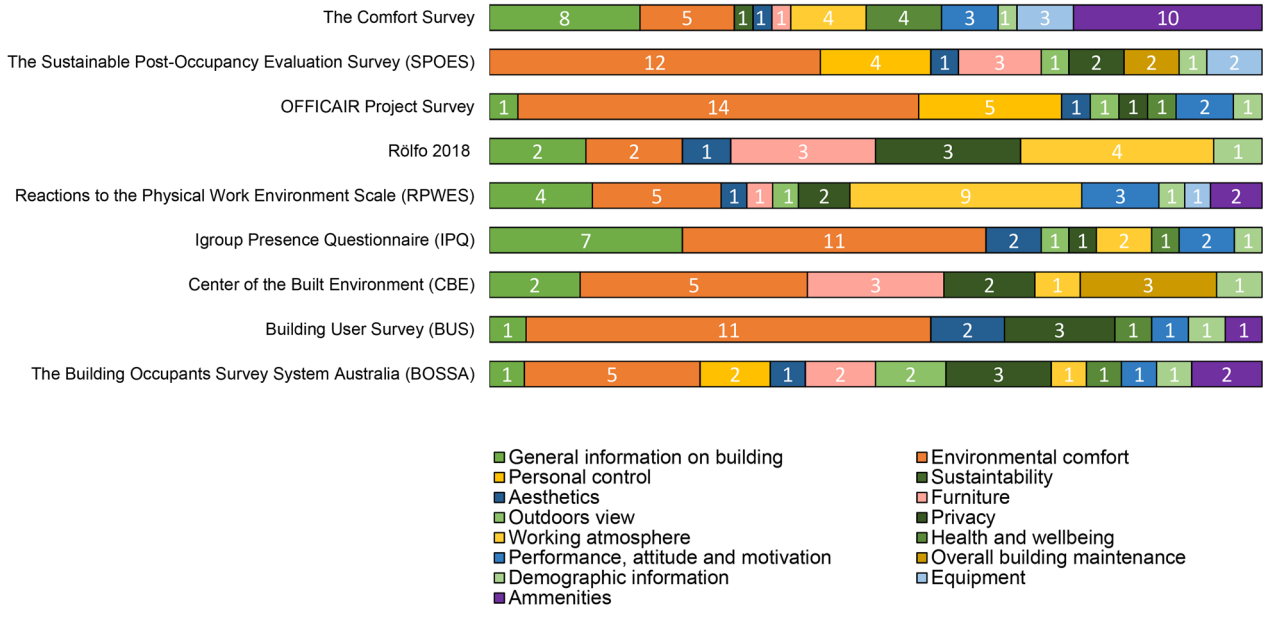


Figure 7. Presents the proportion of survey domains per survey tool, showing that the domain most considered is environmental comfort with 70 items throughout all 9 validated surveys.

influence of the work environment into wellbeing and contentment (Borsos et al. 2021).

The rest of the surveys include a range between 16 and 30 items in diverse domains. Important to note is that tools, such as Building Occupants Survey System Australia (BOSSA), Building User Survey (BUS) and Centre of the Built Environment (CBE) are established and validated tools that are accessible as a service.

To understand the multi-domain spectrum of occupant satisfaction in the office space, Figure 7

summarises what domains have been investigated when evaluating occupant satisfaction with office space.

A total of 230 items are considered within the 9 validated survey tools as parameters for the assessment of occupant satisfaction across 15 domains. Some items change in their terminology but refer to the same category. For instance, 'Satisfaction with the overall noise in one's normal work area' (BOSSA) *vs.* 'Satisfaction with the noise level in one's workspace' (CBE).

Environmental comfort is the most frequently included domain, with a total of 70 items describing six domains: overall environmental comfort, thermal quality, air quality, acoustic quality, visual quality and vibration and movement.

Following acoustics, which is the item that repeats in 8 out of 9 tools, 'temperature' appears in 5 out of 9 validated tools, and 'air quality' in 4 tools.

The occupant satisfaction outcomes identified in this analysis include:

i. Comfort: For example, light comfort (CBE) and the comfort of lighting conditions (IPQ)
ii. Sensation: Such as the 'sensation of direct glare from a light fixture' (IPQ)
iii. Quantity: For instance, the 'quantity of glare' (BUS)
iv. Sufficiency: For example, the 'sufficiency of light brightness' (IPQ)
v. Perception: Including the 'perception of eye fatigue' (IPQ) and, in the context of thermal comfort, 'perception of being too hot, or too cold'.

The CBE survey tool is consistent in measuring satisfaction. In this survey, all questions are framed as: 'How satisfied are you with [item]?'

Similar items are sometimes described differently by various authors, making the tools challenging to compare (see Appendix). For instance, while the BOSSA survey tool asks about occupant satisfaction with the 'light' of the office space, the CBE survey and the OFFICAIR survey inquire about satisfaction with the 'amount of light' and 'visual comfort,' respectively. Likewise, The Comfort Survey uses the term 'light conditions'. Overall, there are 18 items referring to 'light' across all the studies.

The difference in the wording between survey tools may have a different meaning due to the research context, which also difficult the comparison between tools.

Clearly, the survey tool design adapts to the research question of each study. However, some authors acknowledge that although their research only focuses on certain items that influence occupant satisfaction in the office, more comprehensive studies, including a wider range of office design attributes, might be needed (Kim and de Dear 2013; Goins, Jellema, and Zhang 2010).

Also, a study by Zhuang et al. (2022) underlines that 'space decoration factors' (interior design factors), such as space dividers, room colorimetry and cleanliness, were not considered in their tool of choice, although these items could have been important (Zhuang et al. 2022). Schuler et al. also note that certain design variables were not part of the tool used and suggest that adding them could be beneficial (Schuler et al. 1981). Similarly, research by John Goins, Jon Jellema and Hui Zhang highlights that their article focuses on certain symbolic attributes of office design and that further research on other attributes is needed (Goins, Jellema, and Zhang 2010). Also, Dianat et al. agree that more domains should be included to get a broader understanding of the effect of light on occupants' satisfaction (Dianat et al. 2013).

Overall scholars agree that the survey used tools to assess occupant satisfaction in the office space do not include a more comprehensive selection of items and domains that have an impact on occupant's satisfaction with the office space.

It could be important to look at methods from (for example) marketing to understand the methodologies used to increase customer retention (in this case interpreted as occupant retention and engagement in survey systems) and to survey customers in effective ways (for example the Net Promoter Score). Also, to understand the system behind customer rewards (in this case occupant rewards when taking part on a survey). It could also be useful to use established intervention methods such as workshops to engage occupants

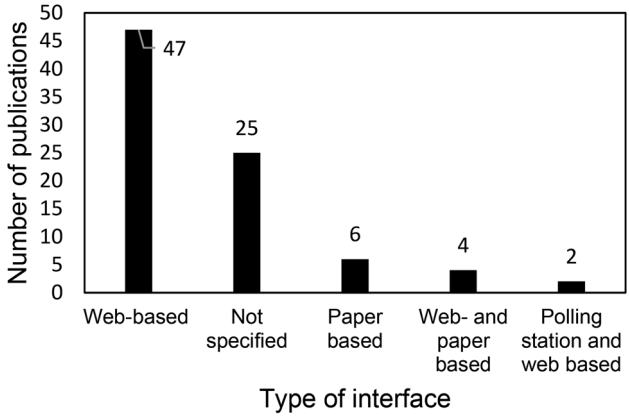
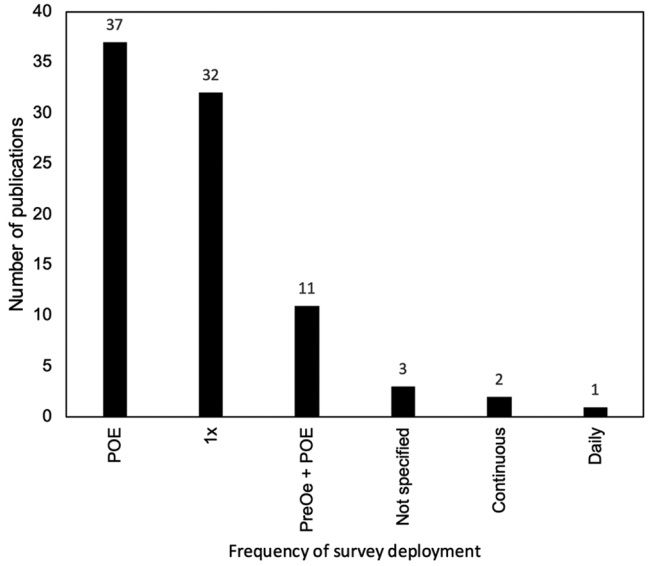


Figure 8. Distribution of survey interfaces for assessing occupant satisfaction. Most studies used online questionnaires, while 25 did not specify the interface type.



POE: Post- Occupancy Evaluation meaning that the information was collected after a change in the office happened

1x: The information was retrieved one time, without any change in the office.

PreOE + POE: At least two surveys were conducted. The first survey was carried out before any changes were implemented in the office. The second survey (and any subsequent ones) were conducted after changes had been made to the office.

Continuous: Information was collected continuously, on demand, more than one time daily

Daily: Respondents were asked to give feedback once daily.

Figure 9. It shows that overall, there have been 5 frequencies used for the deployment of surveys to measure occupant satisfaction. Most publications found have used Post-Occupancy Evaluations. The specification of each type of frequency is found on the right side.

more by explaining them the process, offering extra information and listening to their concerns.

4.4. Interfaces for collecting feedback from users

Overall, questionnaires are mostly distributed by means of web-based interfaces, either desktop or phone. Overall, 47 questionnaires were distributed by means of digital interfaces (see Figure 8), while 25 articles did not specify their interface.

Only two authors applied new methods of presenting a questionnaire through polling stations to provide means for continuous occupant feedback to collect data in real time (Lassen et al. 2020; Lassen, Møller, and Goia 2021; Luna-Navarro and Overend 2021).

According to one research by Lassen et al in 2020 (Lassen et al. 2020), the use of polling stations proved to be an effective way of collecting occupant satisfaction feedback with a five point-scale in form of smileys due to ease of use since it is a cost-efficient alternative which also shows to have higher response rates than other survey types. The study retrieved more than 1300 datapoints with this method. However, the limitation lies upon the fact that there is no control over the participants voting which might include repeated feedback from the same person and bias results.

Similarly, a study by Luna-Navarro and Overend proposed a new type of polling station for laboratory and field studies in real office spaces. In this study, an Internet of Things (IoT) device was placed on the workstation so that participants could give real-time feedback on five environmental factors by pressing colour-coded 'discomfort' buttons: the thermal, air quality, visual, acoustic environment or the level of personal control. The authors emphasised that blending methods (five-point scale questions and discomfort buttons) with different time commitments and data resolution was beneficial to reduce the time effort of occupants. The authors explain that although physical polling stations or questionnaires provide more detailed description of occupants' feedback, but they are more time-intensive, while pressing a button to express discomfort is very fast for occupants, but it is also a less detailed and informative response. This strategy overall was considered effective to provide more accessible and user-friendly methods for continuous feedback (Luna-Navarro and Overend 2021).

4.5. Frequency of data retrieving and duration of studies on occupant satisfaction with office space

The frequency with which data is collected from occupants has strong implications with the office space for both the extent in which information is retrieved in the temporal variations of occupant satisfaction, in relation to changes in weather and seasonal conditions, but also other contextual factors. However, higher frequencies of data collection can also be disruptive to occupants and cause fatigues thereby disengaging occupants with the assessments. Figure 9 illustrates the frequency with which scholars collected information on occupant satisfaction with office spaces in previous work, identifying a total of five distinct retrieval frequencies: Post-Occupancy Evaluations

(POE), one-time surveys without any change (1x), a combination of a survey prior to a change and a post-occupancy evaluation (PreOE + POE), continuous retrievals of information that happen more than one time daily on a voluntary basis (continuous) and daily surveys where respondents were asked to give feedback once per day.

Thirty-seven scholars have conducted POE to survey occupants only after a change in the office environment was performed, either a transformational change within the company (e.g. change management) or one influencing the physical workspace. A total of 32 scholars have utilised one-time surveys to evaluate occupant satisfaction, even if no change was performed in the office. These methods, involving one-time general or post-occupancy questionnaires, are typically fast and less disruptive to occupants, but they retrieve information retrospectively and they ask occupants to 'remember' how they feel in the office space (Babapour Chafi, Harder, and Bodin Danielsson 2020).

A total 11 authors have instead employed both an initial questionnaire and a post-occupancy one to compare occupant response before and after a change or relocation has been performed in the office environment. Research by May et al. emphasise the importance of timing in POE, recommending that data collection occur at least three months after a change or relocation to minimise the risk of the Hawthorne Effect (May et al., 2004).

Despite the well-documented fluctuations in workforce dynamics and employee needs, only eight studies have utilised multiple daily data collections on occupant satisfaction, and just four have implemented daily surveys. The primary barriers to increasing data collection frequency include the potential disruption to occupants and the risk of disengagement due to survey fatigue (Oh, Yeatman, and Trinitapoli 2019). As a result, recent research has explored alternative interfaces and tools that facilitate faster and more frequent data collection, even if it comes at the expense of data resolution.

For instance, Lassen, Møller, and Goia (2021) and Luna-Navarro et al. (2021) suggest that continuous real-time measurement of occupant satisfaction can provide more precise insights. Their studies advocate for the use of polling stations to collect feedback continuously rather than relying on traditional survey methods.

Building on this trend, however from the focus of facility management (FM) rather than for design purposes, Artan et al. (2024) developed the RateWorkspace POE system, a prototype designed to enable continuous feedback collection and visualisation. This system aims to enhance data-driven decision-making in FM by making occupant satisfaction data more accessible and actionable.

Following a similar fashion, Artan et al. (2024) further refined the approach of continuous data collection by identifying key contextual information requirements for integrating occupant feedback into BIM-enabled FM. Their findings propose a structured data collection method that improves building operations and occupant satisfaction. The study concludes that seamless integration of occupant feedback into FM processes can optimise performance, enhance problem resolution and create more responsive workplace environments (Artan et al. 2024).

As reported by Menadue, Soebarto, and Williamson (2013), effective improvements in the design of buildings can only happen if the full temporal scale of occupant satisfaction is captured, enabling the understanding of phenomena that are time dependent. Thus, certain authors experiment collecting data on the office environment three (Veitch et al., 2013) or four times a day for capturing occupant satisfaction in relation to façade performance (Luna-Navarro and Overend 2021), other scholars have done it every second hour (Pathak, Dongre, and Shiwalkar 2014), per minute (Kaushik et al. 2020; Liu et al. 2021) or per second minute (Cakó et al. 2021).

The duration of studies and the frequency of survey deployment has also been considered as a limitation by previous scholars. Often studies have a time constraint, thus, they collect data short term. For example, research by Zagreus et al. specifies in the limitations, that the research was only conducted for two weeks and that could have an impact on the results, meaning that long-term data collection could be an interesting research field (Zagreus et al. 2004).

Although one-time surveys appear to be less disruptive to occupants, further research is needed to determine the optimal frequency for data collection. Continuous real-time measurements are still scarce, but existing studies suggest that this approach could provide more precise insights (Zhang, Wu, and Calautit 2022; Soleimanijavid, Konstantzos, and Liu 2024).

5. Discussion

Overall, the research landscape is fragmented. The geographic distribution of the studies suggests a research gap in office studies across highly populated European countries, such as Germany, despite its significant white-collar workforce. The dominance of U.S.-based research and the strong representation of studies from the UK, Netherlands and Australia indicate that findings may be regionally biased and not

fully representative of diverse workplace environments, policies or cultural contexts. Future research should address this imbalance by expanding studies to underrepresented regions, particularly in continental Europe and emerging economies, to ensure a more comprehensive understanding of workplace dynamics and environmental factors across different socio-economic and climatic conditions.

Our findings highlight the influence of sector demographics on participant composition in workplace studies, raising concerns about the potential gender bias in research findings. Future studies should aim for more gender-balanced samples or acknowledge sector-specific gender distributions as a limitation, ensuring that conclusions about workplace dynamics, autonomy, and collaboration reflect diverse experiences and inform inclusive workplace design and policies. In addition, current research landscape, showed a bias towards corporate office environments, potentially overlooking the unique challenges and spatial dynamics of other office spaces, which may have different workplace cultures and design priorities.

Beyond geographical and sectoral biases, workplace research has also failed to systematically account for differences in user sensitivity to environmental factors, particularly among neurodivergent individuals. Existing studies predominantly reflect neurotypical experiences, overlooking how diverse cognitive and sensory needs influence occupant satisfaction and productivity. Recent research highlights the potential of workplace adaptations (such as noise control, lighting adjustments and decompression spaces) to improve well-being and occupational longevity for neurodivergent workers (Weber et al. 2024). However, the empirical evidence remains limited. Future research should incorporate inclusive frameworks that consider neurodiverse responses to workplace design, ensuring that office environments accommodate a broad spectrum of user needs (Oseland 2021).

In terms of methodology applied, quantitative assessments are most effective when the variable or factor of interest is already known (Rasheed et al. 2021). In the current landscape, qualitative methods are significantly underrepresented, with only two studies relying exclusively on qualitative approaches. While quantitative methods provide measurable insights into workplace satisfaction, they often fail to capture the contextual and experiential depth that influences employee perceptions and behaviours. Qualitative research, by focusing on narrative data rather than numerical outputs, enables a deeper exploration of subjective experiences in office settings (Verhoef and Casebeer 1997). Given the evolving challenges of modern office environments and the need to capture diverse user experiences, future research should prioritise mixed method approaches to complement quantitative data with experiential insights, ensuring a more comprehensive and nuanced analysis. Broadening our findings would enable the design of workspaces that prioritise experiences over purely functional or efficiency-driven approaches, ensuring that environmental conditions align with occupant well-being, comfort and engagement (Mark 2024).

The persistent reliance on standardised quantitative methods has constrained the scope of workplace research, leading to a narrow focus on environmental parameters while overlooking broader office design attributes that significantly influence occupant satisfaction. This limitation is reflected in the fact that most studies continue to assess only conventional factors, such as thermal, acoustic and lighting comfort, with little attention given to spatial usability, amenities or workplace aesthetics. In this sense, The Comfort Survey stands out for considering amenities, such as quiet rooms, lounges, gyms and parking spaces, which are typically overlooked in standard surveys (Thomas 2017). Additionally, two acknowledge that important workplace design elements, such as space dividers, colorimetry and cleanliness, were missing from their chosen tools, suggesting that future surveys should expand their scope to capture a more holistic view of workplace satisfaction (Ozdemir 2010; Windlinger, Nenonen, and Airo 2016).

The diversity of survey tools used in workplace satisfaction research highlights a lack of standardisation, with more than 60 different questionnaires identified. The dominance of bespoke surveys (51 studies) suggests that researchers often design customised tools tailored to specific research questions, rather than relying on validated and widely accepted instruments. While this flexibility allows for context-specific investigations, it hinders comparability across studies and limits the ability to generalise findings. For instance, the design of response scales significantly influences occupant satisfaction results (Giraldo Vasquez, Rupp, and Toftum 2022).

The frequency of data collection in occupant satisfaction studies is crucial for capturing temporal variations in response to seasonal changes and workplace dynamics. One-time surveys and POE remain dominant due to their efficiency and minimal disruption, yet they rely on retrospective recall, missing real-time fluctuations (Langston, Song, and Purdey 2008). High-frequency data retrieval, such as daily or continuous surveys, offers more granular insights but often

leads to survey fatigue and disengagement, reducing data reliability over time (Radun and Hongisto 2023). Studies show that overly frequent assessments risk diminishing response rates, while short-term research durations fail to capture long-term adaptation trends (Oldham 1987; Babapour Chafi, Harder, and Bodin Danielsson 2020; Oh, Yeatman, and Trinitapoli 2019). To balance data richness and participant engagement, hybrid approaches are emerging, integrating structured periodic surveys with passive data collection methods, such as sensors and user-triggered polling stations (Libby et al. 2019; Lassen et al. 2020). A refined, mixed-method approach is necessary to ensure robust, dynamic insights into workplace satisfaction and performance. Gamification could be a strategy to maintain user interest in providing feedback or integrating physiological and behavioural monitoring (Gao et al. 2022). However, the latter could be excessively disruptive or resource intensive for being generalised. Overall, frequency of data retrieval from occupants is an open research question and future studies should investigate new approaches that can strike the balance between the resources needed, the level of disruptiveness to occupants and the quality of data retrieved.

The optimal frequency of data collection depends on the research objective. To effectively inform office space design, data should be gathered throughout all phases – before interventions (to assess occupant needs and spatial challenges), during the building's lifecycle (to capture evolving workforce dynamics through periodic feedback) and after interventions (*via* POEs) to evaluate design effectiveness. A continuous, iterative approach ensures that office environments remain adaptable and responsive to user needs rather than relying solely on static, retrospective assessments.

To make these insights actionable for designers – particularly interior designers and workplace planners – scientific research must go beyond establishing correlations between design variables and occupant responses. It should also develop methodologies that translate findings into evidence-based design strategies applicable during the design process. Given the fragmented nature of existing research and the strong influence of contextual factors, a more structured framework is needed to synthesise findings, assess their generalisability and provide designers with practical, adaptable guidelines.

6. Conclusion

This literature review investigated what are the demographics, methodologies, survey tools, and time frequencies employed to evaluate occupant satisfaction with office design. Its primary aim is to clarify how satisfaction data is currently collected, identify limitations in prevailing approaches and propose future directions for improvement.

This review highlights significant gaps in workplace satisfaction research, including geographic, demographic and methodological biases that limit the generalisability of findings. For instance, this research identifies nine validated surveys encompassing 139 items across 15 domains, which hinders cross-comparison between items or domains.

Current research often focuses on environmental comfort but lacks direct applicability to spatial usability, aesthetics and user interaction with the built environment. Bridging this gap requires interdisciplinary methodologies that integrate rigorous empirical research with design-focused frameworks. Crucially, interior architectural elements – such as spatial layout, aesthetic quality, including preferences of style, texture, combinations, furniture (not only from an ergonomical perspective) and adaptability – remain underrepresented in current research landscape.

Future research should focus on identifying the ideal frequency for data collection throughout the design process, as current findings lack generalisability across different office environments, user groups and spatial contexts. The variability in existing studies – due to sample demographics, location-specific constraints and contextual factors – makes it difficult for designers to rely solely on scientific literature to inform decision-making. While POEs provide valuable feedback, their retrospective nature limits their applicability during the early design phases when critical decisions are made.

To bridge this gap, research should explore dynamic, iterative data collection methods that align with the different stages of the design process, ensuring that occupant needs and environmental performance are continuously evaluated. This would enable evidence-based design approaches that integrate real-time insights, moving beyond static scientific findings to more adaptable and actionable strategies for workplace design.

7. Limitations

This work only investigated the methodologies utilised by previous scientific work, while in industry practices may have other approaches that require further investigation. We suggest for future work to investigate as well as methodologies currently employed by architectural practices to evaluate if and how occupant

satisfaction with office space design is currently being assessed, the methods used and when.

A potential limitation of this literature review is the exclusive reliance on two databases, Scopus and Web of Science. This limited database selection could result in a narrowed perspective. Expanding the database inclusion in future reviews could provide a more comprehensive and balanced analysis.

Disclosure statement

The authors report there are no competing interests to declare. The authors declare no financial conflicts of interest related to this work.

Ethical statement

This research did not involve any human subjects, animals or personal data. It did not collect any personal, sensitive or confidential information that could pose risks to privacy.

This literature review only utilised data that is already in the public domain and does not require special permissions or ethical clearance.

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References

Abeyrathna, W. P., I. S. Ariyarathna, R. U. Halwatura, F. R. Arooz, A. S. Perera, and A. Kaklauskas. 2024. "ANN Prediction Model to Improve Employees' Thermal Satisfaction in Tropical Green Office Buildings." *Asian Journal of Civil Engineering* 25 (1): 343–358. doi:10.1007/s42107-023-00779-y.

Agha-Hossein, M. M., S. El-Jouzi, A. A. Elmualim, J. Ellis, and M. Williams. 2013. "Post-Occupancy Studies of an Office Environment: Energy Performance and Occupants' Satisfaction." *Building and Environment* 69: 121–130. doi:10.1016/j.buildenv.2013.08.003.

Al-Habaibeh, A., M. Watkins, K. Waried, and M. B. Javareshk. 2021. "Challenges and Opportunities of Remotely Working from Home during Covid-19 Pandemic." *Global Transitions* 3: 99–108. doi:10.1016/j.glt.2021.11.001.

Ali Mustafa, F., and S. Abdullah Azeez. 2022. "Role of Office Layout Typology in Saving Time and Distance Spent by Users: Case of Office Buildings in Erbil City." *Ain Shams Engineering Journal* 13 (5): 101742. doi:10.1016/j.asej.2022.101742.

Aminuddin, A. M. R., S. P. Rao, and W. T. Hong. 2012. "Thermal Comfort Field Studies in Two Certified Energy Efficient Office Buildings in a Tropical Climate." *International Journal of Sustainable Building Technology and Urban Development* 3 (2): 129–136. doi:10.1080/2093761X.2012.696324.

Appel-Meulenbroek, R., A. Kemperman, A. van de Water, M. Weijs-Perrée, and J. Verhaegh. 2022. "How to Attract Employees Back to the Office? A Stated Choice Study on Hybrid Working Preferences." *Journal of Environmental Psychology* 81: 101784. doi:10.1016/j.jenvp.2022.101784.

Appel-Meulenbroek, R., B. de Vries, and M. Weggeman. 2017. "Knowledge Sharing Behavior: The Role of Spatial Design in Buildings." *Environment and Behavior* 49 (8): 874–903. doi:10.1177/0013916516673405.

Aristizabal, S., K. Byun, P. Porter, N. Clements, C. Campanella, L. Li, A. Mullan, S. Ly, A. Senerat, I. Z. Nenadic, W. D. Browning, V. Loftness, and B. Bauer. 2021. "Biophilic Office Design: Exploring the Impact of a Multisensory Approach on Human Well-Being." *Journal of Environmental Psychology* 77: 101682. doi:10.1016/j.jenvp.2021.101682.

Artan, D., I. Tekce, N. Yilmaz, and E. Ergen. 2024. "The Contextual Information Requirements for Collection and Use of Occupant Feedback in BIM-Enabled FM." *Facilities* 42 (3–4): 321–341. doi:10.1108/F-03-2023-0028.

Babapour Chafi, M., M. Harder, and C. Bodin Danielsson. 2020. "Workspace Preferences and Non-Preferences in Activity-Based Flexible Offices: Two Case Studies." *Applied Ergonomics* 83: 102971. doi:10.1016/j.apergo.2019.102971.

Babapour, M. 2019. "From Fading Novelty Effects to Emergent Appreciation of Activity-Based Flexible Offices: Comparing the Individual, Organisational and Spatial Adaptations in Two Case Organisations." *Applied Ergonomics* 81: 102877. doi:10.1016/j.apergo.2019.102877.

Bae, S., A. O. Asojo, and C. S. Martin. 2020. "Impact of Occupants' Demographics on Indoor Environmental Quality Satisfaction in the Workplace." *Building Research and Information* 48 (3): 301–315. doi:10.1080/09613218.2019.1627857.

Borsos, Á., E. S. Zoltán, É. Pozsgai, B. Cakó, G. Medvegy, and J. Girán. 2021. "The Comfort Map—a Possible Tool for Increasing Personal Comfort in Office Workplaces." *Buildings* 11 (6): 233. doi:10.3390/buildings11060233.

Bourikas, L., S. Gauthier, N. K. S. En, and P. Xiong. 2021. "Effect of Thermal, Acoustic and Air Quality Perception Interactions on the Comfort and Satisfaction of People in Office Buildings." *Energies (Basel* 14 (2): 333. doi:10.3390/en14020333.

Brown, Z., R. J. Cole, J. Robinson, and H. Dowlatabadi. 2010. "Evaluating User Experience in Green Buildings in Relation to Workplace Culture and Context." *Facilities* 28 (3–4): 225–238. doi:10.1108/02632771011023168.

Cakó, B., E. S. Zoltán, J. Girán, G. Medvegy, M. E. Miklós, Á. Nyers, A. T. Grozdics, Z. Kisander, V. Bagdán, and Á. Borsos. 2021. "An Efficient Method to Compute Thermal Parameters of the Comfort Map Using a Decreased Number of Measurements." *Energies (Basel)* 14 (18): 5632. doi:10.3390/en14185632.

Candido, C., J. Kim, R. De Dear, and L. Thomas. 2016. "BOSSA: A Multidimensional Post-Occupancy Evaluation Tool." *Building Research and Information* 44 (2): 214–228. doi:10.1080/09613218.2015.1072298.

Candido, C., L. Thomas, S. Haddad, F. Zhang, M. Mackey, and W. Ye. 2019. "Designing Activity-Based Workspaces: satisfaction, Productivity and Physical Activity." *Building Research and Information* 47 (3): 275–289. doi:10.1080/09613218.2018.1476372.

Carroll, N., and K. Conboy. 2020. "Normalising the 'New Normal': Changing Tech-Driven Work Practices under Pandemic Time Pressure." *International Journal of Information Management* 55: 102186. doi:10.1016/j.ijinfomgt.2020.102186.

Carthey, J. 2006. "Post Occupancy Evaluation: Development of a Standardised Methodology for Australian Health Projects." *International Journal of Construction Management* 6 (1): 57–74. doi:10.1080/15623599.2006.10773082.

Chatterjee, S., R. Chaudhuri, V. I. González, A. Kumar, and S. K. Singh. 2022. "Resource Integration and Dynamic Capability of Frontline Employee during COVID-19 Pandemic: From Value Creation and Engineering Management Perspectives." *Technological Forecasting and Social Change* 176: 121446. doi:10.1016/j.techfore.2021.121446.

Colenberg, S., R. Appel-Meulenbroek, N. Romero Herrera, and D. Keyson. 2021. "Conceptualizing Social Well-Being in Activity-Based Offices." *Journal of Managerial Psychology* 36 (4): 327–343. doi:10.1108/JMP-09-2019-0529.

D'oca, S., S. Corgnati, A. L. Pisello, and T. Hong. 2016. "Introduction to an Occupant Behavior Motivation Survey Framework."Laurence Berkeley International Laboratory LBNL Report #: LBNL-1004496. URL: https://escholarship.org/uc/item/8td7p9x1

Davis, M. C., D. J. Leach, and C. W. Clegg. 2020. "Breaking Out of Open-Plan: Extending Social Interference Theory Through an Evaluation of Contemporary Offices." *Environment and Behavior* 52 (9): 945–978. doi:10.1177/0013916519878211.

de Vries, A., J. L. Souman, B. de Ruyter, I. Heynderickx, and Y. A. W. de Kort. 2018. "Lighting up the Office: The Effect of Wall Luminance on Room Appraisal, Office Workers' Performance, and Subjective Alertness." *Building and Environment* 142: 534–543. doi:10.1016/j.buildenv.2018.06.046.

Dianat, I., A. Sedghi, J. Bagherzade, M. A. Jafarabadi, and A. W. Stedmon. 2013. "Objective and Subjective Assessments of Lighting in a Hospital Setting: Implications for Health, Safety and Performance." *Ergonomics* 56 (10): 1535–1545. doi:10.1080/00140139.2013.820845.

Dinç, P. 2009. "Gender (in)Difference in Private Offices: A Holistic Approach for Assessing Satisfaction and Personalization." *Journal of Environmental Psychology* 29 (1): 53–62. doi:10.1016/j.jenvp.2008.10.006.

Dole, C., and R. G. Schroeder. 2001. "The Impact of Various Factors on the Personality, Job Satisfaction and Turnover Intentions of Professional Accountants." *Managerial Auditing Journal* 16 (4): 234–245. doi:10.1108/02686900110389188.

Forooraghi, M., E. Miedema, N. Ryd, H. Wallbaum, and M. Babapour Chafi. 2023. "Relationship between the Design Characteristics of Activity-Based Flexible Offices and Users' Perceptions of Privacy and Social Interactions." *Building Research and Information* 51 (5): 588–604. doi:10.1080/09613218.2023.2180343.

Gao, N., M. Marschall, J. Burry, S. Watkins, and F. D. Salim. 2022. "Understanding Occupants' Behaviour, Engagement, Emotion, and Comfort Indoors with Heterogeneous Sensors and Wearables." *Scientific Data* 9 (1): 261. doi:10.1038/s41597-022-01347-w.

Giddings, B., and V. Ladinski. 2016. "Implementation of a Local Authority Workspace Strategy in the UK: The Case of Gateshead Metropolitan Borough Council." *Facilities* 34 (3–4): 196–218. doi:10.1108/F-03-2014-0033.

Giraldo Vasquez, N., Rupp, and R. F. Toftum. 2022. "Analysis of a Questionnaire for Visual Comfort Assessments: Effects of Question Formats."

Göçer, Ö., C. Candido, L. Thomas, and K. Göçer. 2019. "Differences in Occupants' Satisfaction and Perceived Productivity in High- and Low-Performance Offices." *Buildings* 9 (9): 199. doi:10.3390/buildings9090199.

Goins, J., J. Jellema, and H. Zhang. 2010. "Architectural Enclosure's Effect on Office Worker Performance: A Comparison of the Physical and Symbolic Attributes of Workspace Dividers." *Building and Environment* 45 (4): 944–948. doi:10.1016/j.buildenv.2009.09.015.

Graham, L. T., T. Parkinson, and S. Schiavon. 2021. "Lessons Learned from 20 Years of CBE's Occupant Surveys." *Buildings and Cities* 2 (1): 166–184. doi:10.5334/bc.76.

Gupta, A., G. Torriani, S. Torresin, L. Pistore, M. Pellegatti, L. Piazza, F. Miorin, W. Passut, A. Belleri, R. Lollini, F. Babich. 2025.. "Thermal Comfort and Perceived Air Quality (PAQ) using Automatic Ceiling Fans in Residential Buildings." *Energy Build*, 330: 115317. doi: 10.1016/j.jenvp.2022.101920.

Haapakangas, A., A. Ropponen, E. Tulenheimo-Eklund, V. Ruohomäki, and K. Reijula. 2025. "Associations of Perceived Privacy at the Workplace with Short Sickness Absences in a Cohort of Finnish Office Workers." *Journal of Occupational and Environmental Medicine* 67 (2): e127–e131. doi:10.1097/JOM.0000000000003287.

Haapakangas, A., D. M. Hallman, S. E. Mathiassen, and H. Jahncke. 2018. "Self-Rated Productivity and Employee Well-Being in Activity-Based Offices: The Role of Environmental Perceptions and Workspace Use." *Building and Environment* 145: 115–124. doi:10.1016/j.buildenv.2018.09.017.

Haapakangas, A., D. M. Hallman, S. E. Mathiassen, and H. Jahncke. 2019. "The Effects of Moving into an Activity-Based Office on Communication, Social Relations and Work Demands – A Controlled Intervention with Repeated Follow-up." *Journal of Environmental Psychology* 66: 101341. doi:10.1016/j.jenvp.2019.101341.

Hammermann, A., and M. Voigtländer. 2020. "Bürobeschäftigte in Deutschland." 47.

Heidmets, M. E., V. Y. U. Durmanov, and K. A. Liik. 2019. "Apartments and Offices: How to Satisfy Both Planners and Users?" *Psychology. Journal of the Higher School of Economics*. 16 (1): 7–26. doi:10.17323/1813-8918-2019-1-7-26.

Heinzerling, D., S. Schiavon, T. Webster, and E. Arens. 2013. "Indoor Environmental Quality Assessment Models: A Literature Review and a Proposed Weighting and Classification Scheme." *Building and Environment* 70: 210–222. doi:10.1016/j.buildenv.2013.08.027.

Helmold, M. "Management for Professionals New Work, Transformational and Virtual Leadership Lessons from COVID-19 and Other Crises." http://www.springer.com/series/10101

Herbig, B., A. Schneider, and D. Nowak. 2016. "Does Office Space Occupation Matter? The Role of the Number of Persons per Enclosed Office Space, Psychosocial Work Characteristics, and Environmental Satisfaction in the Physical and Mental Health of Employees." *Indoor Air* 26 (5): 755–767. doi:10.1111/ina.12263.

Hong, T., M. Lee, S. Yeom, and K. Jeong. 2019. "Occupant Responses on Satisfaction with Window Size in Physical and Virtual Built Environments." *Building and Environment* 166: 106409. doi:10.1016/j.buildenv.2019.106409.

Indriyati, S. A. 2018. "Designing in Architecture: Behavioral Approach Methodology." www.sciencepubco.com/index.php/IJET

Kamarulzaman, N., A. A. Saleh, S. Z. Hashim, H. Hashim, and A. A. Abdul-Ghani. 2011. "An Overview of the Influence of Physical Office Environments towards Employees." *Procedia Engineering* 20: 262–268. doi:10.1016/j.proeng.2011.11.164.

Kasuganti, A. R. 2018. "Do Ambient Conditions in Offices Impact Learning." *Facilities* 36 (5–6): 291–307. doi:10.1108/F-03-2016-0027.

Kaushik, A., M. Arif, P. Tumula, and O. J. Ebohon. 2020. "Effect of Thermal Comfort on Occupant Productivity in Office Buildings: Response Surface Analysis." *Building and Environment* 180: 107021. doi:10.1016/j.buildenv.2020.107021.

Khanna, S., and J. R. New. 2008. "Revolutionizing the Workplace: A Case Study of the Future of Work Program at Capital One." *Human Resource Management* 47 (4): 795–808. doi:10.1002/hrm.20245.

Kim, A., S. Wang, L. McCunn, and H. Sadatsafavi. 2020. "Impact of Office Modernization on Environmental Satisfaction: A Naturalistic Field Study." *Frontiers in Built Environment* 6: 58. doi:10.3389/fbuil.2020.00058.

Kim, H., C. Y. Cho, and S. W. Hong. 2023. "Impact of Agent-Based Simulation on Novice Architects' Workplace Design Exploration and Trade-Offs." *Automation in Construction* 145: 104635. doi:10.1016/j.autcon.2022.104635.

Kim, J., and R. de Dear. 2013. "Workspace Satisfaction: The Privacy-Communication Trade-off Inopen-Plan Offices." *Journal of Environmental Psychology* 36: 18–26. doi:10.1016/j.jenvp.2013.06.007.

Kim, J., C. Candido, L. Thomas, and R. de Dear. 2016. "Desk Ownership in the Workplace: The Effect of Non-Territorial Working on Employee Workplace Satisfaction, Perceived Productivity and Health." *Building and Environment* 103: 203–214. doi:10.1016/j.buildenv.2016.04.015.

Kim, J., R. de Dear, C. Cândido, H. Zhang, and E. Arens. 2013. "Gender Differences in Office Occupant Perception of Indoor Environmental Quality (IEQ)." *Building and Environment* 70: 245–256. doi:10.1016/j.buildenv.2013.08.022.

Knight, C., and S. A. Haslam. 2010. "The Relative Merits of Lean, Enriched, and Empowered Offices: An Experimental Examination of the Impact of Workspace Management Strategies on Well-Being and Productivity." *Journal of Experimental Psychology. Applied* 16 (2): 158–172. doi:10.1037/a0019292.

Kwon, M., and H. Remøy. 2019. "Office Employee Satisfaction: The Influence of Design Factors on Psychological User Satisfaction." *Facilities* 38 (1–2): 1–19. doi:10.1108/F-03-2019-0041.

Labib, Z., K. Nabil, and K. Amin. 2023. "A Spatial Design Guideline for Supporting Creativity at Architectural Firms." *HBRC Journal* 19 (1): 63–85. doi:10.1080/16874048.2023.2212543.

Langston, C., Y. Song, and B. Purdey. 2008. "Perceived Conditions of Workers in Different Organizational Settings." *Facilities* 26 (1–2): 54–67. doi:10.1108/02632770810840309.

Lassen, N., and F. Goia. 2021. "A Theoretical Framework for Classifying Occupant-Centric Data Streams on Indoor Climate Using a Physiological and Cognitive Process Hierarchy." *Energy and Buildings* 241: 110935. doi:10.1016/j.enbuild.2021.110935.

Lassen, N., F. Goia, S. Schiavon, and J. Pantelic. 2020. "Field Investigations of a Smiley-Face Polling Station for Recording Occupant Satisfaction with Indoor Climate." *Building and Environment* 185: 107266. doi:10.1016/j.buildenv.2020.107266.

Lassen, N., J. K. Møller, and F. Goia. 2021. "Information Match between Continuous Occupant Data Streams and One-Time Manual Surveys on Indoor Climate." *Building and Environment* 204: 108087. doi:10.1016/j.buildenv.2021.108087.

Lee, Y. S., and D. A. Guerin. 2010. "Indoor Environmental Quality Differences between Office Types in LEED-Certified Buildings in the US." *Building and Environment* 45 (5): 1104–1112. doi:10.1016/j.buildenv.2009.10.019.

Lee, Y. S., and S. Kim. 2008. "Indoor Environmental Quality in LEED-Certified Buildings in the U.S." *Journal of Asian Architecture and Building Engineering* 7 (2): 293–300. doi:10.3130/jaabe.7.293.

Lei, Q., S. S. Y. Lau, C. Yuan, and Y. Qi. 2022. "Post-Occupancy Evaluation of the Biophilic Design in the Workplace for Health and Wellbeing." *Buildings* 12 (4): 417. doi:10.3390/buildings12040417.

Libby, E., J. Sander, A. Caza, and P. J. Jordan. 2019. "Psychological Perceptions Matter: Developing the Reactions to the Physical Work Environment Scale." *Building and Environment* 148: 338–347. doi:10.1016/j.buildenv.2018.11.020.

Liu, X., S. Lee, I. Bilionis, P. Karava, J. Joe, and S. A. Sadeghi. 2021. "A User-Interactive System for Smart Thermal Environment Control in Office Buildings." *Applied Energy* 298: 117005. doi:10.1016/j.apenergy.2021.117005.

Luna-Navarro, A., and M. Overend. 2021. "Design, Construction and Validation of MATELab: A Novel Outdoor Chamber for Investigating Occupant-Facade Interaction." *Building and Environment* 203: 108092. doi:10.1016/j.buildenv.2021.108092.

Luna-Navarro, A., P. Fidler, A. Law, S. Torres, and M. Overend. 2021. "Building Impulse Toolkit (BIT): A Novel IoT System for Capturing the Influence of Façades on Occupant Perception and Occupant-Façade Interaction." *Building and Environment* 193: 107656. doi:10.1016/j.buildenv.2021.107656.

Ma, J. H., and S. H. Cha. 2021. "A User-Specific Activity Pattern Generation Framework for Evidence-Based ABW Planning." *Building and Environment* 189: 107519. doi:10.1016/j.buildenv.2020.107519.

Mark, D. 2024. *Experiential Design Schemas*. Torrance, CA: ORO Editions.

Marzban, S., C. Candido, M. Mackey, L. Engelen, F. Zhang, and D. Tjondronegoro. 2023. *A Review of Research in Activity-Based Working over the Last Ten Years: Lessons for the post-COVID Workplace*. Bingley: Emerald Publishing. doi:10.1108/JFM-08-2021-0081.

Masoudinejad, S., and J. A. Veitch. 2023. *The Effects of Activity-Based Workplaces on Contributors to Organizational Productivity: A Systematic Review*. Cambridge, MA: Academic Press. doi:10.1016/j.jenvp.2022.101920.

May, D. R., C. E. Schwoerer, K. Reed, and P. Potter. 2004. "Ergonomic Office Design and Aging: A Quasi-Experimental Field Study of Employee Reactions to an Ergonomics Intervention Program." *Journal of Occupational Health Psychology* 9 (2): 123–135. doi:10.1037/1076-8998.9.2.123.

Menadue, V., V. Soebarto, and T. Williamson. 2013. "The Effect of Internal Environmental Quality on Occupant Satisfaction in Commercial Office Buildings." *HVAC and R Research* 19 (8): 1051–1062. doi:10.1080/10789669.2013.805630.

Morrison, R. L., and R. K. Smollan. 2020. "Open Plan Office Space? If You're Going to Do It, Do It Right: A Fourteen-Month Longitudinal Case Study." *Applied Ergonomics* 82: 102933. doi:10.1016/j.apergo.2019.102933.

Morrow, P. C., J. C. McElroy, and K. P. Scheibe. 2012. "Influencing Organizational Commitment through Office Redesign." *Journal of Vocational Behavior* 81 (1): 99–111. doi:10.1016/j.jvb.2012.05.004.

Nairobi, K. "Impact of Hybrid Working Systems on Employee Wellbeing in Professional Services Firms: A Case Study of PricewaterhouseCoopers."

Najjar, G. A., K. Akkad, and A. H. Almahdaly. 2023. "Classification of Lighting Design Aspects in Relation to Employees' Productivity in Saudi Arabia." *Sustainability (Switzerland* 15 (4): 3614. doi:10.3390/su15043614.

Oh, J. H., S. Yeatman, and J. Trinitapoli. 2019. "Data Collection as Disruption: Insights from a Longitudinal Study of Young Adulthood." *American Sociological Review* 84 (4): 634–663. doi:10.1177/0003122419859574.

Oldham, G. R. 1988. "Effects of Changes in Workspace Partitions and Spatial Density on Employee Reactions: A Quasi-Experiment."

Oldham, G. R. 1987. "Employee Reactions to Workspace Characteristics."

Ong, B. L. 2013. *Beyond Environmental Comfort*. 1st ed. Abingdon: Taylor and Francis.

Ornstein, S. W., B. Chaves, C. Leite, C. Âudia, and M. De Andrade. (a). "Office Spaces in Sa Ä o Paulo: Post-occupancy Evaluation of a High Technology Building." http://www.emerald-library.com

Ornstein, S. W., B. Chaves, C. Leite, C. Âudia, and M. De Andrade. (b). "Occupancy Evaluation of Offices in the Financial Sector." http://www.emerald-library.com/ft

Oseland, N. 2021. "Beyond the Workplace Zoo: Humanising the Office." doi:10.1201/9781003129974.

Ozdemir, A. 2010. "The Effect of Window Views' Openness and Naturalness on the Perception of Rooms' Spaciousness and Brightness: A Visual Preference Study." *Scientific Research and Essays* 5 (16): 2275–2287. http://www.academicjournals.org/SRE.

Page, M. J., et al. 2021. *The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews*. London: BMJ Publishing Group. doi:10.1136/bmj.n71.

Parkin, J. K., S. A. Austin, J. A. Pinder, T. S. Baguley, and S. N. Allenby. 2011. "Balancing Collaboration and Privacy in Academic Workspaces." *Facilities* 29 (1–2): 31–49. doi:10.1108/02632771111101313.

Parkinson, T., S. Schiavon, J. Kim, and G. Betti. 2023. "Common Sources of Occupant Dissatisfaction with Workspace Environments in 600 Office Buildings." *Buildings and Cities* 4 (1): 17–35. doi:10.5334/bc.274.

Pathak, P. M., A. R. Dongre, and J. P. Shiwalkar. 2014. "Impact of Spatial, Thermal and Lighting Parameters on the Efficiency and Comfort of Users in Indian Workspaces." *Journal of Sustainable Development* 7 (4): 111–123. doi:10.5539/jsd.v7n4p111.

Paul, W. L., and P. A. Taylor. 2008. "A Comparison of Occupant Comfort and Satisfaction between a Green Building and a Conventional Building." *Building and Environment*. 43 (11): 1858–1870. doi:10.1016/j.buildenv.2007.11.006.

Permana, A. Y., H. Nurrahman, and A. F. S. Permana. 2021. "Systematic Assessment with 'Poe' Method in Office Buildings Cases Study on the Redesign Results of Office Interior after Occupied and Operated." *Journal of Applied Engineering Science* 19 (2): 448–465. doi:10.5937/jaes0-28072.

Poupard, M., C. Mateev, and F. Mantelet. 2019. "Optimizing the Design of a Workspace Using a Participatory Design Method." In *Advances in Intelligent Systems and Computing*, 944–955. Berlin, Germany: Springer Verlag. doi:10.1007/978-3-319-96071-5_97.

Radun, J., and V. Hongisto. 2023. "Perceived Fit of Different Office Activities – The Contribution of Office Type and Indoor Environment." *Journal of Environmental Psychology* 89: 102063. doi:10.1016/j.jenvp.2023.102063.

Rasheed, E. O., M. Khoshbakht, and G. Baird. 2019. "Does the Number of Occupants in an Office Influence Individual Perceptions of Comfort and Productivity? New Evidence from 5000 Office Workers." *Buildings* 9 (3): 73. doi:10.3390/buildings9030073.

Rasheed, E. O., M. Khoshbakht, and G. Baird. 2021. "Time Spent in the Office and Workers' Productivity, Comfort and Health: A Perception Study." *Building and Environment* 195: 107747. doi:10.1016/j.buildenv.2021.107747.

Rashid, M., J. Wineman, and C. Zimring. 2009. "Space, Behavior, and Environmental Perception in Open-Plan Offices: A Prospective Study." *Environment and Planning B: Planning and Design* 36 (3): 432–449. doi:10.1068/b33034.

Riratanaphong, C., and B. Chaiprasien. 2020. "The Impact of Workplace Change of a Private Jet Company on Employee Satisfaction." *Facilities* 38 (13–14): 943–960. doi:10.1108/F-10-2019-0114.

Riratanaphong, C., and N. Narmwiset. 2023. "Employees' Appraisal of Workplace Changes during COVID-19: findings from a State-Owned Oil and Gas Company." *Nakhara: Journal of Environmental Design and Planning* 22 (1): 306. doi:10.54028/NJ202322306.

Rolfö, L. V. 2018. "Relocation to an Activity-Based Flexible Office – Design Processes and Outcomes." *Applied Ergonomics* 73: 141–150. doi:10.1016/j.apergo.2018.05.017.

Sakellaris, I., D. Saraga, C. Mandin, Y. de Kluizenaar, S. Fossati, A. Spinazzè, A. Cattaneo, T. Szigeti, V. Mihucz, E. de Oliveira Fernandes, K. Kalimeri, P. Carrer, and J. Bartzis. 2019. "Personal Control of the Indoor Environment in Offices: Relations with Building Characteristics, Influence on Occupant Perception and Reported Symptoms Related to the Building-the Officair Project." *Applied Sciences (Switzerland)* 9 (16): 3227. doi:10.3390/app9163227.

Schuler, R. S., L. P. Ritzman, and V. Davis. 1981. "Merging Prescriptive and behavioral Approaches For Office Layout."

Schwede, D. A., H. Davies, and B. Purdey. 2008. "Occupant Satisfaction with Workplace Design in New and Old Environments." *Facilities* 26 (7–8): 273–288. doi:10.1108/02632770810877930.

Scrima, F., A. L. Mura, M. Nonnis, and F. Fornara. 2021. "The Relation between Workplace Attachment Style, Design

Satisfaction, Privacy and Exhaustion in Office Employees: A Moderated Mediation Model." *J Environ Psychol* 78: 101693. doi:10.1016/j.jenvp.2021.101693.

Sediso, B. G., and M. S. Lee. 2016. "Indoor Environmental Quality in Korean Green Building Certification Criteria—Certified Office Buildings—Occupant Satisfaction and Performance." *Science and Technology for the Built Environment* 22 (5): 606–618. doi:10.1080/23744731.2016.1176849.

Shahzad, S., J. Brennan, D. Theodossopoulos, B. Hughes, and J. K. Calautit. 2017. "Energy and Comfort in Contemporary Open Plan and Traditional Personal Offices." *Applied Energy* 185: 1542–1555. doi:10.1016/j.apenergy.2016.02.100.

Sirola, P., A. Haapakangas, M. Lahtinen, and V. Ruohomäki. 2022. "Workplace Change Process and Satisfaction with Activity-Based Office." *Facilities* 40 (15–16): 17–39. doi:10.1108/F-12-2020-0127.

Soleimanijavid, A., I. Konstantzos, and X. Liu. 2024. "Challenges and Opportunities of Occupant-Centric Building Controls in Real-World Implementation: A Critical Review." *Energy and Buildings* 308: 113958. doi:10.1016/j.enbuild.2024.113958.

Taskin, L., M. Parmentier, and F. Stinglhamber. 2019. "The Dark Side of Office Designs: Towards De-humanization."

Thomas, L. E. 2017. "Combating Overheating: mixed-Mode Conditioning for Workplace Comfort." *Building Research and Information* 45 (1–2): 176–194. doi:10.1080/09613218.2017.1252617.

Tiara, S., and A. Gamal. 2021. "The Correlation Between Spatial Configuration and User Satisfaction: A Case Study of an Activity-Based vs a Conventional Office." *International Journal on Advanced Science, Engineering and Information Technology* 11 (2): 648–655. doi: 10.18517/ijaseit.11.2.12643

Van Der Voordt, T. J. M. 2004. "Productivity and Employee Satisfaction in Flexible Workplaces." *Journal of Corporate Real Estate* 6 (2): 133–148. doi:10.1108/14630010410812306.

Veitch, J. A., M. G. M. Stokkermans, and G. R. Newsham. 2013. "Linking Lighting Appraisals to Work Behaviors." *Environment and Behavior* 45 (2): 198–214. doi:10.1177/0013916511420560.

Verhoef, M. J., and A. L. Casebeer. 1997. "Broadening Horizons: Integrating Quantitative and Qualitative Research." *Canadian Journal of Infectious Diseases and Medical Microbiology* 8 (2): 65–66. doi:10.1155/1997/349145.

Vischer, J. C., and M. Wifi. 2017. "The Effect of Workplace Design on Quality of Life at Work." In *Handbook of Environmental Psychology and Quality of Life Research*, 387–400. Berlin, Germany: Springer International Publishing. doi:10.1007/978-3-319-31416-7_21.

Weber, C., B. Krieger, E. Häne, J. Yarker, and A. McDowall. 2024. "Physical Workplace Adjustments to Support Neurodivergent Workers: A Systematic Review." In *Applied Psychology*, 910–962. Hoboken, NJ: John Wiley and Sons Inc. doi:10.1111/apps.12431.

Windlinger, L., S. Nenonen, and K. Airo. 2016. "Specification and Empirical Exploration of a Usability Concept in the Workplace." *Facilities* 34 (11–12): 649–661. doi:10.1108/F-01-2015-0003.

Wong, M. O., Z. Zheng, H. Liang, J. Du, S. Zhou, and S. Lee. 2023. "How Does VR Differ from Renderings in Human Perception of Office Layout Design? A Quantitative Evaluation of a Full-Scale Immersive VR." *Journal of Environmental Psychology* 89: 102043. doi:10.1016/j.jenvp.2023.102043.

Woo, J., P. Rajagopalan, M. Francis, and P. Garnawat. 2021. "An Indoor Environmental Quality Assessment of Office Spaces at an Urban Australian University." *Building Research and Information* 49 (8): 842–858. doi:10.1080/09613218.2021.1944037.

Yildirim, K., A. Ozkan, E. Gunes, and A. Mestan. 2020. "cz^." *Facilities* 38 (7–8): 577–594. doi:10.1108/F-11-2018-0145.

Zagreus, L., C. Huizenga, E. Arens, and D. Lehrer. 2004. ", "Listening to the Occupants: A Web-Based Indoor Environmental Quality Survey." In *Indoor Air, Supplement*, 65–74. Oxford: Blackwell Munksgaard. doi:10.1111/j.1600-0668.2004.00301.x.

Zerella, S., K. von Treuer, and S. L. Albrecht. 2017. "The Influence of Office Layout Features on Employee Perception of Organizational Culture." *Journal of Environmental Psychology* 54: 1–10. doi:10.1016/j.jenvp.2017.08.004.

Zhang, W., Y. Wu, and J. K. Calautit. 2022. "A Review on Occupancy Prediction through Machine Learning for Enhancing Energy Efficiency, Air Quality and Thermal Comfort in the Built Environment." *Renewable and Sustainable Energy Reviews* 167: 112704. doi:10.1016/j.rser.2022.112704.

Zhuang, D., T. Wang, V. J. L. Gan, X. Zhao, Y. Yang, and X. Shi. May 2022. "Supervised Learning-Based Assessment of Office Layout Satisfaction in Academic Buildings." *Building and Environment* 216: 109032. doi:10.1016/j.buildenv.2022.109032.

Appendix

The table below presents an analysis of the nine validated survey tools identified in this literature review. The table is organised into domains, such as general information on the office building, environmental comfort and aesthetics, and it specifies the survey items that correspond to each domain.

Domains	Items	The Building Occupants Survey System Australia (BOSSA)	Building User Survey (BUS)	Centre of the Built Environment (CBE)	Igroup Presence Questionnaire (IPQ)	Reactions to the Physical Work Environment Scale (RPWES)	Rölfo (2018)	OFFICAIR Project Survey	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	The Comfort Survey
General Information on building	Overall building information	Satisfaction with building overall	Satisfaction with overall needs being met	Satisfaction with personal workspace		-Satisfaction with the physical work environment -Preference of office type	-Satisfaction with the functionality of the new office	Satisfaction with the office layout		-Satisfaction with the office space -Preference of workstation location -Time spent in office weekly -Adjustability of workstation -Workstation preference -Satisfaction with the atmosphere of the work environment
	Spatial comfort and layout	Satisfaction with the amount of workspace		Satisfaction with the amount of space available for individual work and storage	-Perception of workspace size -Spatial Comfort -Sense that the space is (narrow/wide) -Feeling of openness/ closeness -Satisfaction with openness	-Satisfaction with the workplace separation -Satisfaction with the distance to colleagues				-Importance of workstation size -Importance of workstation flexibilty
	Tasks						-Match between work tasks and office design			-Ranking of Work tasks -Time of sedentary work -Time of movement (standing up, using the bathroom, drinking water, meeting with colleagues)
	Facade							Types of solar shading devices present		Satisfaction with the shading in one's work environment

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Domains	Items	The Building Occupants Survey System Australia (BOSSA)	Building User Survey (BUS)	Centre of the Built Environment (CBE)	Igroup Presence Questionnaire (IPQ)	Reactions to the Physical Work Environment Scale (RPWES)	Rölfo (2018)	OFFICAIR Project Survey	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	The Comfort Survey
Environmental comfort	Thermal quality	Satisfaction with the temperature conditions in one's work area (in summer and winter)	-Comfort overall -Comfort of temperature in summer and winter -Stability of temperature in summer and winter -Perception of temperature in summer and winter	Satisfaction with temperature in one's workspace		Satisfaction with the temperature		-Satisfaction with overall temperature comfort -Temperature variation (too hot, too cold)	-Satisfaction with the overall thermal conditions -Satisfaction with the temperature (hot/cold)	Satisfaction with the temperature in one's work environment
	Air quality	Satisfaction with overall air quality in one's work area	Perception of air freshness in summer and winter	Satisfaction with air quality in one's workspace (stuffy/stale air, cleanliness, odours)		Satisfaction with the airflow		-Satisfaction with overall air quality -Satisfaction with air freshness Satisfaction with odour	-Satisfaction with the overall indoor air quality (IAQ) -Satisfaction with the air velocity (drafty or stagnant) -Satisfaction with the humidity (dry or moist)	-Satisfaction with the ventilation in one's work environment -Satisfaction with the odours, smells in one's work environment
	Acoustic quality	Satisfaction with the overall noise in one's normal work area	Satisfaction with overall noise	Satisfaction with the noise level in one's workspace		Satisfaction with the noise level	-Satisfaction with the speech volume level one can hear from one's workstation -Satisfaction with the speech volume	-Satisfaction with overall noise -Satisfaction with outside noise -Satisfaction with nose from building systems -Satisfaction with noise within the building	-Satisfaction with the overall acoustic quality -Satisfaction with the ability to hear desired sound	Satisfaction with the volume, noise in one's work environment
	Visual quality	-Satisfaction with the lighting comfort of one's normal work area (amount of light, glare, reflections, contrast) -Satisfaction with the access to daylight from one's normal work area	-Satisfaction with overall lighting -Quantity of natural light -Quantity of artificial light -Quantity of glare from natural light	-Satisfaction with the amount of light in one's workspace -Satisfaction with the visual comfort of the lighting (glare, reflections, contrast)	-Visual comfort in one's workspace -Satisfaction with the current illumination -Satisfaction with current light source -Sensation of direct glare from a light fixture -Sensation of glare from the wall, floor, or desktop -Satisfaction with colour temperature of light -Sufficiency of light brightness -Visibility of texts -Perception of eye fatigue -Stress by reflected light -Comfort of lighting condition	-Satisfaction with the visual comfort -Satisfaction with the amount of light		-Satisfaction with overall light -Satisfaction with natural lighting -Satisfaction with artificial lighting -Satisfaction with glare	-Satisfaction with the amount of daylighting -Satisfaction with daylightning conditions -Satisfaction with the amount of electric lightning -Satisfaction with the overall electric lighting conditions	Satisfaction with the illumination in one's work environment
	Vibration and movement							Satisfaction with the vibration	Satisfaction with the overall vibration and movement	

(*Continued*)

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Domains	Items	The Building Occupants Survey System Australia (BOSSA)	Building User Survey (BUS)	Centre of the Built Environment (CBE)	Igroup Presence Questionnaire (IPQ)	Reactions to the Physical Work Environment Scale (RPWES)	Rölfo (2018)	OFFICAIR Project Survey	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	The Comfort Survey
Personal control	Overall personal control	Satisfaction with the degree of freedom to adapt one's normal work area (air-conditioning, opening the window, lighting, etc.) to meet one's preferences						-Type of light control -Operability of windows -Type of mechanical ventilation control -Type of room temperature control -Type of solar shading control (individual, central down, individual up, automatic, no control)	-Satisfaction with the adjustability of the daylighting -Satisfaction with the adjustability of the electric lighting -Satisfaction with the adjustability of the task lightning -Satisfaction with the adjustability of the thermal conditions	Adjustability of light source
Sust.	Sustainability									Importance of sustainability
Aesthetics	Overall aesthetics	Satisfaction with the office aesthetics	-Satisfaction with building design -Perception of overall office image		-Satisfaction with space (room or interior) -Pleasantness with Interior space	Satisfaction with the aesthetics of the workspace	Satisfaction with the aesthetics of the workplace	Satisfaction with the office decoration	Satisfaction with the overall appearance (aesthetics)	Importance of architectural character
Furniture	Furniture and furnishings	-Comfort of Furnishings -Satisfaction with the amount of personal storage		-Satisfaction with comfort of furnishings (chair, desk, computer equipment) -Satisfaction with the ability to adjust furniture to one's needs -Satisfaction with colours and textures of flooring, furniture and surface finishes		Satisfaction with the functionality of furniture	-Satisfaction with the possibility to adjust the furniture to meet one's individual needs (chairs, tables, drawers,…) -Satisfaction with furniture functionality (chairs, tables, drawers,…) -Satisfaction of storage opportunities		-Satisfaction with the overall furnishings -Satisfaction with the adjustability of the furnishings -Satisfaction with the function of the furnishings	Adjustability of workstation
Outdoor view	Overall Outdoor view	-Connection to outdoor environment -External view			Comfort with window views	Satisfaction with the outdoor view		Satisfaction with views from the windows	Satisfaction with the overall view conditions	
Privacy	Overall Privacy	Agreeability that the office layout allows one to work without distractions or unwanted interruptions -Satisfaction with acoustic privacy -Visual privacy	-Frequency of interruptions -Satisfaction with acoustic privacy -Visual privacy	Satisfaction with the sound privacy in one's workspace (ability to have conversations without neighbours overhearing and vice versa)	-Satisfaction with the level of visual privacy	-Amount of disturbance -Satisfaction with the possibility pf privacy	-Satisfaction with the degree of privacy with walls, separation panels, and furnishings around one's workplace -Satisfaction with the acoustic privacy at one's desk -Satisfaction with the visual privacy at one's workstation	Satisfaction with the amount of privacy	-Satisfaction with the overall privacy -Satisfaction with the ability to limit undesired sound	

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Domains	Items	The Building Occupants Survey System Australia (BOSSA)	Building User Survey (BUS)	Centre of the Built Environment (CBE)	Igroup Presence Questionnaire (IPQ)	Reactions to the Physical Work Environment Scale (RPWES)	Rölfo (2018)	OFFICAIR Project Survey	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	The Comfort Survey
Working atmosphere	Social interactions	Satisfaction with the work area's layout in terms of interaction with colleagues		Satisfaction with ease of interaction with co-workers	Sense of being looked at	-Quality of intra-team communication -Quality of intra-team spreading of ideas -Quality of inter-team spreading of ideas	-Quality of the within team cooperation -Quality of the between-team cooperation -Quality of the working atmosphere between one and one's colleagues			-Satisfaction with the opportunity for interaction -Satisfaction with the opportunities for being alone
	Feeling of belonging				-Feeling of isolation -Feeling space is 'owned'	Amount of collegial help -Organisation Connectedness -Part of the organisation -Part of a community -General connectedness -feeling of belonging	Feeling of belonging part of a community at the place of work			Satisfaction with one's community
Health & Wellbeing	Health	Valence of work area influencing one's health	Perception of health		Perception of mind and body tiredness			Perception of building related health issues		-Influence of diverse factors on health --Feeling at the office in the last two weeks (happy and cheerful, calm and relaxed, lively and active, etc.) -Influence of workplace choice into wellbeing and contentment -Influence of IEQ into wellbeing and contentment
Performance, attitude and motivation	Performance	Valence of work area influencing one's productivity	Perception of productivity		-Motivation because of space -Ability to focus	-Amount of individual performance -Amount of individual productivity -Opportunity to participate in design of the new office		-Perception of productivity in other locations inside the building -Perception of productivity at one's workstation		Availability of spaces where one can be productive -Availability of spaces where one can concentrate -Availability of spaces where one can communicate

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Domains	Items	The Building Occupants Survey System Australia (BOSSA)	Building User Survey (BUS)	Centre of the Built Environment (CBE)	Igroup Presence Questionnaire (IPQ)	Reactions to the Physical Work Environment Scale (RPWES)	Rölfo (2018)	OFFICAIR Project Survey	The Sustainable Post-Occupancy Evaluation Survey (SPOES)	The Comfort Survey
Overall Building Maintenance	Building maintenance			-Satisfaction with the general building maintenance -Satisfaction with the cleanliness with the overall building -Satisfaction with the cleaning service provided for your workspace					-Satisfaction with the building maintenance -Satisfaction with the building cleanliness	
Demographic	Demographic	Demographic information	Demographic information	Demographic information	Demographic information	Demographic information	Demographic	Demographic	Demographic	Demographic information
Equipment	Overall office equipment					Satisfaction with the access to equipment			-Satisfaction with the overall technology -Satisfaction with the access to electric outlets	-Satisfaction with the office equipment -Availabilty of special equipment (height adjustable table, a special chair, more than 1 screen) -Importance of self support equipment availability
Amenities	Services of comfort	-Agreeability with adequate formal and informal spaces to collaborate with others -Pleasantness with space for breaks	Perception of facilities meeting one's work needs			-Ratio of informal meetings -Ratio of spontaneous meetings				-Importance of services of comfort -Importance of meeting rooms availability -Importance of quiet areas availability -Importance of kitchen availability -Importance of lounges availability -Importance of gyms availability -Importance of sports facilities availability -Importance of parking spaces availability -Importance of accessibly (available car parking, public transport, bicycle) -Importance of location of building

Alt Text Appendix: A table analysing nine validated survey tools identified in the literature review. The table is structured into domains, including general information on the office building, environmental comfort and aesthetics. Each domain is associated with specific survey items, detailing how different tools assess various aspects of occupant satisfaction.