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Trondheim, Norway

Editors:

Riikka Kyrö
Vitalija Danivska



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24th EuroFM Research Symposium
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Preface

This book comprises the Proceedings of the 24th EuroFM Research Symposium, organized 1-2 December 2025 in connection with the 30th EuroFM Conference in Trondheim, Norway. The theme of the 2025 Research Symposium is the highly topical 'Social FM', which inspired and is reflected in all 32 papers included these proceedings. The papers were presented at the conference under two tracks, one focusing on Workplace Management and the other on broader Facility Management topics. The sessions in the Workplace Management track explored Indoor Environmental Quality, Academic workplaces, and Hybrid work. Sessions under the FM track delved into Social Sustainability, Future proofing, Management and Maintenance, and FM Services.

We would like to express our gratitude to all authors for their diligence, commitment, and kind cooperation during the entire process. We are honored that so many researchers find our Research Symposium to be a suitable platform for dissemination. It is such a privilege to have all of you in the EuroFM research community!

All submitted papers have been subject to a rigorous double blind-review process, made possible by a group of engaged academics. Our Scientific Committee 2025 has 34 members from Australia, Belgium, Denmark, Finland, Germany, Italy, the Netherlands, Sweden, Switzerland, the UK and the USA. Thank you all so much!

Our thanks also to the Best Paper Committee for evaluating the candidates and selecting the recipient of the Best Paper Award 2025. Congratulations to Bintang Prabowo, the author of the winning paper Community-Based Facility Management in an Urban Experiment Area: Case Svartlamon. The topical research paper explores an under-researched field of FM and may be found on page 175 of this book.

We extend our thanks to all Session Chairs at the Research Symposium: Susanne Colenberg, Savis Gohari, Nore Johanne Klungseth, Carmel Lindkvist, Mark Mobach, Suvi Nenonen, Nipuni Sumanarathna, and Alenka Temeljotov-Salaj. We wish to thank our hosts at the Norwegian University of Science and Technology (NTNU). The researchers thoroughly enjoyed the Welcome reception, Charity Dinner, and post-conference event at the Granåsen Winter Sports Arena.

Finally, we wish to thank Niels Peters for creating the beautiful cover design for these proceedings. The EuroFM Research Network wants to promote Open Access (OA) research, and these proceedings are freely available to all readers via Zenodo. In line with EuroFM's three pillars, Research, Education, and Business, we want to encourage everyone to explore this state-of-the-art European FM research. We hope you will gain new insights from reading the proceedings, regardless of your background—researcher, educator, student, or practitioner.

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Workplace Research

Participatory Research In FM: A Review of the Walkthrough Interview Method

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ABSTRACT

Background and Aim. Walkthrough interviews are a participatory method for studying people-place relationships. As such, they could engage users and offer rich information about the perceived identity and functionality of spaces, explaining their utilization. However, this method seems to have been applied mainly in outdoor environments and for studying social issues rather than places. This paper explores its potential to facility management (FM) as a method for user-centred development and evaluation of indoor spaces.

Methods and Data. In this literature review, ten peer-reviewed methodological papers on walkthrough interviews in multiple disciplines were analysed to identify approaches and practices relevant to research on indoor spaces. We analysed the discussed strengths, limitations, ethical considerations, and the reported practical details of the walkthrough interview method, synthesizing them into a participatory research framework for FM.

Results. Key benefits of walkthrough interviews include richer data, spontaneous and reliable feedback, insights into sensory experiences and everyday routines, and access to specific user groups and settings. The method's flexibility allows for different interview setups catering different research objectives. Challenges include participant and bystander privacy, physical capabilities of participants, recording multiple data types on the move, and the complex data analysis.

Originality. This paper advances FM knowledge by outlining existing approaches to this contextual and participatory research method and discussing its value to FM research by synthesizing methodological and ethical considerations when applied indoors.

Practical Implications. The paper offers guidelines for conducting walkthrough interviews in buildings for understanding occupants' needs and creating inclusive spaces.

Type of Paper. Full research

KEYWORDS. facilities, indoor environments, mobile interviews, participatory methods, walking interviews

INTRODUCTION

Facility management (FM) is responsible for keeping spaces safe and comfortable and supporting building users' productivity and well-being (IFMA, n.d.). This implies that FM has a crucial role in creating inclusive and engaging environments that meet the diverse needs and preferences of their occupants. For example, equipment and arrangement of workstations, and interior design, as well as indoor environmental conditions may affect the usability of the workspace for diverse categories of people (Tagliaro et al., 2024). The spatial arrangement and workplace design may support social connection and foster a sense of belonging among employees (Spreitzer et al., 2019), which is especially relevant in today's hybrid working models. Moreover, Redlein (2020) states that in workplace management, the goal of FM is to empower employees to support achieving business goals.

By actively engaging end-users (employees, students, patients, residents, visitors) in research and decision-making processes, FM could ensure that facilities address the real-world challenges faced by

users and accommodate a wide range of user needs, including those related to gender, neurodiversity, physical disabilities, and cultural backgrounds. This requires research methods that provide deep, user-centred insights. Walkthrough interviews may offer a valuable participatory approach that directly engages end-users as they interact with their environments (Bartlett et al, 2023; Marcotte et al., 2022). Unlike traditional survey methods that rely on recalled experiences, walkthrough interviews capture real-time, context-specific perceptions and feedback, uncovering nuanced details about how spaces are used and experienced (Alexander et al., 2019; Chang, 2016). The qualitative data gathered in walkthrough interviews can complement quantitative measures like occupancy rates and energy usage and provide a holistic understanding of user needs and experiences. By involving end-users in the assessment process, FM may identify hidden issues and generate actionable insights that lead to more effective, efficient, and inclusive solutions.

Since its introduction to research in the built environment by Kusenbach (2003), walkthrough interviews are increasingly used to study, for example, people's relationships with their neighbourhoods (Marcotte et al., 2022) or the experience of physical disability (Bartlett et al., 2023). To date, conducting walkthrough interviews to study buildings through occupants' experiences seems rare although Rasila et al. (2009) already proposed to integrate facility-oriented walkthrough audits with customer journeys for measuring end-user experience in FM. Building on their work, this paper aims to draw the potential of walkthrough interviews as a participatory research method for user-centred development and evaluation of indoor spaces by answering the following research question: *Which benefits, challenges, and ethical aspects of the walkthrough interview method are relevant to FM?*

THEORETICAL BACKGROUND

Participatory research in FM

A participatory research approach involves stakeholders (e.g., owners, occupants, and community members) in the research process, from defining the problem to gathering data and analysing results. The goal of user participation is to ensure that the research reflects the needs, perspectives, and expertise of those directly impacted by the issues being studied (Vaughn & Jacquez, 2020). Participatory research approaches in the built environment may include (a) surveys, which gather data directly from users about their experiences, needs, and preferences, (b) observational studies, which help understanding how spaces are used in real-time, (c) interviews with representatives of building users about their experiences and opinions, and (d) participatory action research, which refers to involving stakeholders in the entire process of identifying problems, implementing solutions, and evaluating outcomes. In essence, participatory research is systematically collecting and analysing data with the users rather than on them (Reason & Torbert, 2001). Recognizing the expertise of the participants, it aims to share responsibility for the research process beyond mere involvement (Brown, 2022), with researchers and community members as equal partners (e.g., Schneid & Raz, 2020).

Participatory research approaches can provide content-rich, nuanced data and an ethical base for decision-making. They enable FM to tailor interventions to specific needs, making them more successful, and promote a sense of ownership, which increases acceptability (Buffey et al, 2024; Brown, 2022; Vaughn & Jaquez, 2020). In this manner, applying participatory approaches may bring FM enhanced user satisfaction, improved functionality and efficiency of the work environment, and innovative solutions, provided that the research results are truly considered in the decision making by FM professionals. Building strong relationships with stakeholders helps FM professionals better understand and respond to user needs, improving service delivery (Vaughn & Jacquez, 2020).

Walkthrough interview methods

The walkthrough or walking interview is an inductive qualitative research method where the interviewer accompanies participants on a walk in a specific environment or location, gathering data by asking questions, listening, and observing (Kusenbach, 2003; Evans & Jones, 2011). Based on the method's different purposes, we distinguish two types of these mobile interviews: 'place-oriented' and

'person-oriented'. In our view, place-oriented walkthrough interviews aim to understand specific places through the participant's perceptions, experiences, and interactions with them. This category is primarily concerned with how the physical environment shapes and influences the users' thoughts and behaviours, and with solving physical problems such as challenges faced by individuals with mobility issues (Butler & Derrett, 2014). Since these interviews take a spatial perspective, we call them walkthrough interviews. Note that in FM, the term 'walkthrough' may also refer to building assessment without conducting interviews, for example, the user-led spatial walkthroughs as discussed by Babapour Chafi and Cobaledo Cordero (2020). Furthermore, in technology and product design, a (cognitive) 'walkthrough' may refer to a user navigating a website or using an object, identifying their interactions and pitfalls, rather than examining places (e.g., Mahatody et al., 2010).

In contrast to these place-oriented interviews, person-oriented walking interviews prioritize the individual's experiences, stories, and narratives elicited through cues in the environment and the informal setting of walking together (Anderson, 2004). In the literature, they are often referred to as walking interviews, go-along, or walk-and-talk methodology. In their ethnographic nature, they focus on social issues like the context of social networks, daily routines, or personal memories tied to certain places, and mapping the data is not prioritized (Jones et al., 2008). This narrative or biographical type of mobile interviews is used to, for example, explore how immigrants understand the concept of 'home' (e.g. Fathi, 2023). We acknowledge that in practice, this division may not be crystal clear, for example when the interviews focus on the dynamic interplay between places and users, or on a specific group (Alexander et al., 2019) rather than emphasizing either space or narrative. For example, when generating more site-specific data to better understand the impact of the physical environment and national dispersing policies on refugees' home-making processes (Van Liempt & Staring, 2021).

Walkthrough interviews are inherently participatory because participants actively engage with the environment, providing real-time feedback. Participants can choose specific areas or elements to focus on, share experiences and perceptions influenced by being in the space, and explain their interactions and feelings about the environment as they move through it (Rafiei & Gifford, 2023). In this manner, walkthrough interviews provide real-time feedback and capture nuances that surveys may miss. They can also highlight issues related to safety, accessibility, and inclusivity, leading to more equitable spatial planning (Evans & Jones, 2011). Different approaches can serve different objectives, where a largely unstructured walkthrough might be useful for initial broad observations and a more structured walkthrough interview with specific tasks can shed light on more targeted areas of interest. In built environment research, place-oriented walkthrough interviews may capture occupants' experiences better than sit-down interviews because people normally move through the environment, taking in the scene from several perspectives (Rafiei & Gifford, 2023).

While walkthrough interviews have been used for a while, the idea of making them place-oriented for a broader spectrum of disciplines is relatively new. Moreover, because different disciplines use the method under different names and in various ways, the understanding of its potential is fragmented. Therefore, this paper brings together literature from multiple disciplines to present methodological considerations and examples of practical approaches to place-oriented walkthrough interviews in indoor spaces, highlighting the potential of this user-engaging methodology to FM research.

LITERATURE REVIEW APPROACH

To explore the existing knowledge about place-oriented walkthrough interviews as a qualitative data-collection method and identify potential benefits and challenges to applications in the FM context, we conducted a methodological literature review (Furlong & Lester, 2023) using purposive sampling.

In the reputable index of Scopus, we entered a search string that combined terms referring to (a) the research method of walkthrough interviews and (b) the built environment and indoor space as FM's main sphere of influence. The complete search string was: "walkthrough interview*" OR "walking interview*" OR "mobile interview*" OR "spatial walkthrough*" OR "environmental walkthrough*" OR

"go-along interview*" OR "walk-along interview*" OR "commentated walk*" OR "walk-and-talk interview*") AND ("built environment" OR "building" OR "space*" OR "place" OR "indoor" OR "setting" OR "interior" OR "facilities".

This search1 was limited to peer-reviewed articles and reviews published in English. In April 2025, it retrieved 381 documents. Most papers were published in the past five years, showing a sharp rise of the method's popularity. Since we aimed for a detailed analysis of the walkthrough interview method's benefits and challenges from an FM perspective rather than providing a complete overview of its applications in empirical studies, we deliberately selected information-rich papers on this topic applying two inclusion criteria:

- The paper's main aim was to discuss strengths and limitations of the walkthrough interview method, explicitly focusing on a methodological reflection rather than empirical outcomes.
- The paper addressed aspects of place-oriented walkthrough interviews, for example, about capturing physical features of the environment or analysing the role of the built environment.

Over 80% of the collected papers did not meet the first criterion. Additionally, several methodological papers did not focus on data-collection through mobile interviews in a physical environment, but, for example, on the use of video technology or 'cognitive walkthroughs' examining a product. Applying purposive sampling, we selected ten highly cited papers from a variety of disciplines including several publications of less than three years old. To assess the walkthrough interview method's suitability to purposes and populations in the FM context, we analysed (a) the method's benefits, challenges, and ethical considerations that were discussed in each paper, and (b) their descriptions of practical approaches to data collection via walkthrough interviews. From the examples of empirical studies that were included in the papers we extracted further details about employed research designs and data-collection preparations.

FINDINGS FROM THE METHODOLOGICAL PAPERS

Half of the selected methodological reflection papers were written from a health perspective and considered walkthrough interviews as a method to investigate the built environment's impact on health-related issues (Bartlett et al., 2023, Carpio, 2009; Chang, 2017; Garcia et al., 2012; Marcotte et al., 2022). Four papers considered the method's utility for urban planning (Evans & Jones, 2011; Finley & Bowman, 2017; Walshe & Law, 2024) and leisure studies (Alexander et al., 2019), and one discussed the benefits for organizational studies (Bilsland & Siebert, 2024). Four were published in methodological journals dedicated to qualitative research methods, the rest in thematic journals. Beside their methodological reflection on walkthrough interviews, all ten papers reported at least one empirical study with walkthrough interviews as a data-collection method to substantiate or illustrate their statements. Alexander et al. (2019) reported two studies and Bartlett et al. (2023) included 23 studies in their qualitative systematic review. We used the empirical studies embedded in the methodological papers to gather practical details about data-collection procedures.

In this results section, we first summarize the benefits, challenges, and ethical considerations that were discussed in the selected papers and which we deem relevant to FM. Next, we outline practical aspects of conducting walkthrough interviews that may be relevant to FM, highlighting the differences with traditional sit-down interviews in a random single space.

Reported methodological and ethical considerations of walkthrough interviews

The selected papers discussed a variety of methodological strengths and limitations and ethical aspects to consider when using walkthrough interviews for data collection. Table 1 (next page) highlights benefits, challenges and ethical considerations that may be especially relevant to the discipline of FM, considering its emphasis on indoor spaces and very diverse populations of end-users.

Potential value to FM based on reported benefits of walkthrough interviews

The most important advantage of the walkthrough-interview method emerging from the papers is the richness of the generated data. During walkthrough interviews, both the researcher and the participant are exposed to sensory stimulation by the environment, which contributes to the interpretation of the data (Evans & Jones, 2011; Chang, 2016). The walking seems to create a more relaxed atmosphere in which participants talk more spontaneously and openly about their relationship with the places. Finlay and Bowman (2017) also noted that participants were less concerned with trying to give the 'right' answers, which makes the data more reliable. Prompted by what they see, participants can retrieve their experiences more easily and the connection facilitates the interpretation of the data. Secondly, the papers report how the method's flexibility and adaptability allow including unexpected places and topics, which can, for example, reveal daily routines and barriers in the environment. Based on the researchers' observations of the environment, they can ask questions that otherwise would not have been addressed (Alexander et al., 2019). Chang (2016) argues that this 'room for the unexpected' improves the potential for theory construction.

Table 1 Potential benefits, challenges, and ethical considerations of walkthrough interviews discussed in the selected papers and relevant to FM

Potential benefits to FM	Potential challenges to FM	Ethical considerations
Direct and concrete feedback about features of the physical environment [3, 6, 9]	Technical issues with audio-recording, e.g. due to moving [3, 7] and background noise [1, 5, 7, 9], especially in group interviews [1]	Explicit consent of participants to have their interviews recorded [4, 8, 9]
Richer insights into embodied and sensory experiences [4, 6, 9, 10]	Loosing data if non-verbal signs are not noticed [3, 7, 9]	Preventing recording of conversations of ignorant others who come within the microphone range [5, 9]
Insights in users' everyday behaviours, habits, and routines [all]	It may be difficult to register the exact location of the statements, e.g. in complex buildings [7, 9]	Considering whether photography and/or videography is too sensitive or not allowed in the environment [9]
Revealing barriers in the environment that impact functionality [8, 10]	The physical activity of (long) walking and standing may exclude people from participating [1, 2, 7, 8]	Not audio-recording to make the interview lighter [5]
Revealing implicit knowledge [1, 2, 6, 8, 9]	Some spaces may be unfavorable to conversing due to e.g. crowding or lack of privacy [7, 9]	Discretion in displaying interview materials [4]
Richer and more reliable data due to an informal atmosphere [3, 5, 6, 9]	Sometimes, moving does not provide more information than a sit-down interview [7]	Offering alternatives or breaks for those who cannot walk well [2, 4]
Access to specific user groups [2, 7, 8]	Challenging analysis due to combination of interview data and spatial information [2, 3, 9]	Empowering occupants by giving them control over topics and places [all]
Access to specific settings [5, 6, 9]		
Including unexpected places and topics [4, 9]		
Flexibility and adaptability of e.g., route, questions, pace [all]		
The contemplative potential of walking [8, 9]		

Note: [1] Carpiano (2009); [2] Evans & Jones (2011); [3] Garcia et al. (2012); [4] Chang (2017); [5] Finlay & Bowman (2017); [6] Alexander et al. (2019); [7] Marcotte et al. (2022); [8] Bartlett et al. (2023); [9] Bilsland & Siebert (2024); [10] Walshe & Law (2024)

Reported challenges of walkthrough interviews relevant to FM

An important challenge of walkthrough interviews discussed in the papers is the lack of environmental control compared to static interviews in a pre-arranged space. This may compromise the participants' privacy and focus and challenge the data recording. For example, Walshe and Law (2024) report how school children disturbed the interviews with teachers, and their noise reduced

intelligibility. The researchers used sound editing software to improve the recording afterwards. Several others (e.g., Bilsland & Siebert, 2024; Marcotte et al., 2022; Garcia et al., 2012; Carpiano, 2009) also mention noise and encounters with acquaintances as potential challenges. Furthermore, the moving itself can pose challenges since taking notes while walking is difficult, and some people may have trouble walking or standing for longer periods of time. All authors reported limitations related to the qualitative nature of semi- or unstructured interviews which requires common practices regarding careful sampling and reducing researcher bias. Specific to walkthrough interviews may be the influence of the researcher's and participants' experience with the environment and the power relations between them. The papers report for example explicitly discussing the position of the researcher (Chang, 2017), formalising procedures to minimize differences across interviews (Carpiano, 2009; Garcia et al., 2012), inductively generating a codebook through descriptive and simultaneous coding (Garcia et al., 2012), or triangulation with other research methods (Carpiano, 2009).

Ethical considerations

Several ethical aspects that were discussed in the papers refer to the auditory and visual privacy of both the participants and the other people present in the environment during the interviews. They highlight the informed consent of participants, anonymization of data, and dealing with accidentally recordings of non-participants. In some cases, the privacy of the participant may require hiding signs which could show they are being interviewed (Chang, 2016). A second category of ethical considerations is the potential of walkthrough interviews to empower the participants. For FM, this may improve their relationships with stakeholders.

Reported practical approaches to walkthrough interviews

Settings and purposes of the walkthrough interviews

Many of the reported empirical studies concerned urban environments or neighbourhoods and most were focused on health-related research questions. For example, Chang (2016) describes doing walkthroughs with formerly homeless women in San Francisco to understand how the built and social environment shaped the participants' substance use and health. Bartlett et al. (2023) include several studies with physically disabled people that use walkthrough interviews to reveal barriers in the built environment. Other purposes of walkthrough interviews include empowerment of specific user groups, such as people with autism (Marcotte, 2022) or dementia (Bartlett et al., 2023) or making it easier to talk about sensitive topics like sexual health (Garcia et al., 2012).

The selected papers included only a few examples of studies on the experience of indoor spaces. Bilsland and Siebert (2024) used walking interviews to study how the parliament building shaped social practices that facilitate or hinder institutional change. They found, among other things, that visits to the unattractive basement offices were accompanied by narratives on inadequate working conditions. In residential settings, Marcotte et al. (2022) focused on the inside of the participants' homes and Finlay and Bowman (2017) asked participants for a short tour of their indoors and outdoors living environment. Both Garcia et al. (2012) and Alexander et al. (2019), who focused on a theme rather than on a specific environment, had participants taking them to several relevant indoor spaces, such as a print-making shop, specific leisure and sports centres, and a university student service centre.

Research designs of the reported empirical studies

Based on the empirical studies that were reported in detail, walkthrough interviews were often embedded in a broader qualitative or mixed-methods approach to gain a deeper insight in the participants' experiences or compare them to the perspectives of other users. In several cases, the walkthrough interviews were complemented with sit-down interviews with other stakeholders (Walshe & Law, 2024; Marcotte et al., 2022; Evans & Jones, 2011; Carpiano, 2009). Sit-down interviews with members of the same target group usually aimed at comparing methods rather than deepen insights (Bilsland & Siebert, 2024, Evans & Jones, 2011). Finlay and Bowman (2017) started every interview sitting down to discuss routines, interactions, and well-being before setting out on a walking

'tour' through the neighbourhood led by the participant. Carpiano (2009) complemented his walkthrough interviews with observations of community meetings, a mapping exercise, and a background survey.

Reported data-collection setups and procedures

The data collection of the reported empirical studies rarely includes any systematic recording of the visited spaces' physical features in addition to those highlighted by the participants. Only Evans and Jones (2011) report the recording of environmental factors such as noise levels, crowding, and weather conditions, and used a qualitative GIS technique to integrate time-stamped interview transcripts and GPS tracks to measure environmental effect on walking pace and interview duration. Carpiano (2009) and Chang (2016) mention taking field notes of local areas, for example physical conditions of buildings and the extent and type of surveillance, but this seems to be prompted by the interview rather than pre-arranged. The varied set-ups of walkthrough interviews included in the papers (Table 2) illustrate the flexibility and adaptability of this qualitative research approach.

Based on the empirical examples in the selected papers, the main differences with data collection through traditional sit-down interviews in a dedicated meeting room are being on the move, recording spatial aspects, less control of the environment (noise, privacy, distractions), and potentially more control for the participant. Options for group size, recruiting participants, and structuring the interview may be similar to sit-down interviews, involving different considerations depending on the spatial context. Bilsland and Siebert (2024) provide a comprehensive practical guide for indoor walking interviews addressing thorough preparations, recording equipment, and suggestions for the analysis.

Table 2 Reported data-collecting procedures specific to walkthrough interviews

Procedure	Reported varieties
Interview stages	Warming-up interview and/or concluding session (e.g. Garcia et al., 2016)
Walking route	Researcher-led: places relevant to study (e.g. Marcotte et al., 2022) Participant-led: e.g. daily routine, meaningful places (Evans & Jones, 2011) Collaboratively/spontaneously during interview (e.g. Bilsland & Siebert, 2024)
Privacy during the interview	Respecting the privacy of bystanders during the interview (Garcia et al., 2016) If desired, reducing visibility of interviewing process to outsiders (Chang, 2016) Discussing strategies for dealing with 'intruders' (Bilsland & Siebert, 2024)
Recording on the move	Audio via clipped-on microphone(s) (Walshe & Law, 2024), or small handheld recorder (Chang, 2016) Reflective notes on what could not be recorded (Finlay & Bowman, 2017; Walshe & Law, 2024)
Collecting place/location data	GPS-tracking (Evans & Jones, 2011) Photography by participant (Chang, 2016) or researcher (Marcotte et al., 2022) Annotating maps/floorplans (Bilsland & Siebert, 2024)

DISCUSSION

Walkthrough interviews for user-centred assessment of indoor spaces

Although currently, walkthrough interviews are mainly used outdoors (Marcotte et al., 2022), they may be very useful as a user-centred assessment of indoor spaces since their physical aspects directly impact users. By walking through a building along with its users, the researcher can directly observe how the participant emotionally reacts to and interacts with the space while listening to their comments, which adds to the understanding of their experience. The architecture, furnishings, objects and other occupants of the building can prompt discussions about the experience of a specific indoor space, its functionality, and the social dynamics within the building. Since indoors, the sensory experiences may be caused by technical installations, interior finishes, and spatial layout, this may provide FM with concrete opportunities for improvement.

Although in smaller buildings there may be less opportunity for longer walks, the spontaneity and informal atmosphere may still elicit more rich information than sit-down interviews in a static environment (Chang, 2016). In larger buildings, such as hospitals, navigation may be as relevant as outdoors (Bilsland & Siebert, 2024). Moreover, since indoors there may be less disruptions and limitations from weather and traffic, the quality of the data may be better than with outdoor interviews. Difficulties in capturing data while walking, such as the risk of instable video recordings (Evans and Jones, 2011), have now been largely overcome by new technology. Recently, Arntson and Yoon (2023) showed how mobile devices enable conducting walkthrough interviews remotely. Specific challenges of conducting walkthrough interviews indoors may include access and recording restrictions due to safety and security regulations, more prominent risks of privacy violation, and poor acoustics which could repel participants and reduce audio-recording quality.

Walkthrough interviews for creating inclusive spaces

The results suggest that the walkthrough-interview method can support FM in creating inclusive spaces if environmental, technical, and privacy concerns are addressed. This participatory method empowers participants by allowing them more control over discussion topics (Miaux et al., 2016). This may be especially beneficial in research with vulnerable groups, such as those with physical or mental disabilities, as the method is supportive rather than restrictive (Bartlett et al., 2023). Its flexibility accommodates participants' needs, for instance, by permitting mobility aids and frequent breaks. Furthermore, walkthrough interviews can help FM involve marginalized groups and understand their needs. The environment acts as a 'memory aid' for people with dementia, enhancing their participation compared to traditional memory-reliant interviews (Bartlett et al., 2023). For those with autism, walkthrough interviews offer a less confrontational and more experience-focused method than face-to-face interviews (Marcotte et al., 2022). In offices, this method may reveal the experiences of employees with (temporary) physical or mental impairments, such as fatigue or sensory sensitivity, for example, due to burn-out complaints, hormonal processes, or medical treatment. Finally, by 'walking along', researchers experience the environment through the eyes of the participant, gaining a richer and more accurate view of how the environment affects people's lives and well-being (Versey, 2022). As such, walkthrough interviews are effective in revealing both material and culturally specific barriers in the environment (see e.g., Castrodale, 2018). By walking together, these obstacles are directly experienced and discussed. They also allow researchers to respond 'in the moment' to environmental characteristics and events, leading to a more natural conversation that is informed by both memories and direct observations.

Implications for scientific research in FM

This paper provides FM researchers with a framework for applying walkthrough interviews as a participatory data-collection method. It brings together important literature about this topic and outlines methodological and ethical considerations for conducting walkthrough interviews in indoor spaces and with specific user groups. Limitations of this literature review concern the use of a large yet single data base, the limited sample, and the subjective screening of the papers. To FM scholars, this paper may serve as a starting point for further exploration and development of this qualitative research method in the FM context. Priorities for methodological development may include (a)

instruments and protocols for systematically recording the spaces' physical features to enable conclusions about the relationship between people and places, (b) procedures and technology for integrating qualitative insights from walkthrough interviews with quantitative metrics, e.g. from sensors, surveys, or systematic observations and qualitative data, e.g. from focus groups, literature, or photography, and (c) rapid and efficient applications. Future research, for example a systematic review of studies which conducted walkthrough interviews in indoor spaces could further substantiate the methodological considerations from FM perspective and provide additional details about data-collection issues and use of technology. Additionally, interviews with researchers who applied the method in indoor space could provide first-hand experience of practical issues for FM that may not be included in scientific papers. These contextual insights may contribute to tailoring the method to the FM context.

Implications for applied research in FM

This literature study highlights the potential of walkthrough interviews of providing FM practitioners with in-depth, real-time user feedback on indoor spaces, as a basis for more effective, user-centred development and evaluation of physical environments. The presented framework could serve as a practical source for FM researchers about how to gather contextualized insights aiming at enhancing inclusivity and an optimal fit between buildings and users. We recommend applying walkthrough interviews in post-occupancy evaluations and the regular monitoring of client satisfaction to reveal detailed insights about space utilization and user experience, such as hidden barriers to specific user groups. They can complement surveys, which are based on recalled experiences, and occupancy measures, which capture momentary presence, with insights about motivations behind the behaviour. The presented framework can be utilized in FM education to encourage the use of participatory, adaptable, and responsive research practices.

CONCLUSIONS

This paper explored the potential of walkthrough interviews as a participatory research method for FM through an analysis of methodological reflection papers. Our analysis indicates that walkthrough interviews are particularly effective in capturing real-time, context-specific user experiences which traditional methods might miss, and can offer rich, nuanced insights into occupants' interactions with and experience of indoor spaces. The method's flexibility and adaptability enable tailoring to the wide variety of environments and user groups in FM. Walkthrough interviews hold significant potential for FM in gathering contextual insights for effective and inclusive spaces but requires further development regarding collecting data indoors, capturing environmental features, and integrative analysis.

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Exploring the Theory of Supportive Design from Patient Perspective

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ABSTRACT

Background and Aim. Many patients experience anxiety during hospitalization. Hospital environments can support patients with the mitigation of anxiety. The aim of this study was to gain a better understanding of which design elements can affect sense of control, social support, and positive distraction, and gain more understanding of the mediating variables of anxiety-reducing effects of the physical inpatient room design.

Methods and Data. A qualitative study was conducted to further this theory. Data of this study were collected as part of a larger online survey. In this questionnaire, 539 participants filled in open-ended questions regarding their experiences and thoughts of the inpatient room design. Direct content analysis was conducted to analyse the data.

Findings. Findings suggest that the supportive role of design goes beyond sense of control, positive distraction, and social support, and that the role of a pleasant atmosphere should be included. Moreover, findings suggest that the theory of supportive design may benefit from further description and refinement with related concepts from environmental psychology.

Originality. This study emphasizes the importance of better understanding the spatially-induced psychological mechanism, and, by doing so, to increase the impact of the hospital environment on its users.

Practical Implications. The findings allow hospitals to better understand patient experience in single-bed inpatient rooms and to make better-informed decisions.

Type of Paper. Full research

KEYWORDS. anxiety, inpatient room design, patient perspective, theory of supportive design

INTRODUCTION

Many patients experience stress during hospitalization (Andrade & Devlin, 2015; Zijlstra, 2021). Patients in healthcare facilities are exposed to two main sources of stress: (1) illnesses and (2) physical-social environments (Ulrich, 1991). A large body of evidence shows that stress can suppress healing, so in addition to support the psychological well-being, it is very important to reduce stress to fasten recovery during hospitalization (Walburn et al., 2009).

A considerable amount of research is available about the physical environment that can improve patient outcomes in hospital environments and can turn into so-called healing environments (Elf et al., 2024; Harris et al., 2002; Stichler, 2001; Ulrich et al., 2008). Several studies have shown the impact of single inpatient room design with elements such as plants, view on nature, daylight, and opportunity for social support can positively influence patients' physical and psychological well-being (Dijkstra, 2009; Suess & Mody, 2018; Ulrich et al., 2004). Although elements seem to have a positive impact on patient anxiety, the psychological mechanism through which the physical environment affects anxiety needs to be explored further.

The Theory of Supportive Design conceptualizes that the physical-social environment can reduce patient anxiety by improving the sense of control, access to social support and positive distraction (Ulrich, 1991). This theory has been tested in a few studies, but results do not fully confirm the theory and suggest that other mediating variables may influence anxiety (Andrade et al., 2017; Andrade & Devlin, 2015; Zijlstra et al., 2024). More knowledge about the mediating processes of the influence of the inpatient room design on patient anxiety is essential for facilitating the quality of health care. Undertaking such a study can offer a better understanding of how individual design elements work together in reducing anxiety which can help designers to achieve solutions in meeting the needs of patients. The research question of this study was: Which potential supportive design strategies related to anxiety reduction can be identified from the patient perspective in inpatient rooms?

LITERATURE STUDY

The Theory of Supportive Design provides guidance on how healthcare facilities can be designed to reduce anxiety and focus on three mediating concepts.

Firstly, sense of control can be defined as “the individual perception that he or she can execute (or has the potential to execute) some action that changes an aversive stimulus” (Steptoe & Appels, 1989). Aversive stimuli are unpleasant stimuli that can increase anxiety. The experience of hospitalization is often accompanied by personal loss of control and can result in high stress levels (Ulrich, 1991). By way of illustration, hospitalized patients often cannot get out of bed, close the curtains themselves, decide when to receive visitors or when to leave the room. The theory suggests that a sense of control can eliminate or diminish negative experiences from aversive stimuli. Well-known examples of aversive stimuli in the healthcare environment are noise from corridors, beeps from medical equipment, lack of privacy or hearing conversations of others at the corridor (Maben et al., 2016; Zijlstra et al., 2020, 2023). Ulrich (1991) suggests that the physical environment can facilitate patients by fostering a sense of control. For example, studies suggest that individual control over lighting, temperature, privacy and help requests can increase the sense of control (Hesselink et al., 2020).

Secondly, social support can be defined as the ability to experience benefits from frequent or prolonged contact with family and friends who are helpful, caring, or otherwise supportive (Ulrich, 1991). Social support can affect health by regulating thoughts, feelings, and behavior and can promote health (House et al., 1988; Park & Giap, 2020). Greater perceived social support has been associated with more positive feelings and less anxiety, most importantly under stressful circumstances (Turner, 1981). Ulrich’s theory (1991) suggests that the physical environment can facilitate access to social support. For example, in the early 70’s research showed the impact of seating arrangements on social interactions in an experimental room in a healthcare setting (Holahan, 1972). Furniture arrangement, such as chairs positioned around small tables in the center of a room, can increase social interaction. Moreover, the presence of relatives during hospitalization can contribute to stress reduction (Mason, 2003). A recent study (Zijlstra et al., 2024) found that when patients perceived more social support in a hospital room, they perceived less anxiety.

Thirdly, positive distraction can be defined as “an environmental feature or element that elicits positive feelings, holds attention and interest without taxing or stressing the individual, and therefore may block or reduce worrisome thoughts” (Ulrich, 1991). He suggests that when stimulation is too high the environment is stressful, and when stimulation is too low the environment causes both boredom and stress. This corresponds with the mechanism that distraction can be seen as a passive process, as part of attentional deployment (Webb et al., 2012). Passive distraction is when people are not explicitly asked to shift their attention from the stressful situation but are provided with positive distractors. Ulrich (1991) suggests that happy, laughing, or caring faces, animals, and nature elements (i.e., trees, plants, water) might be positive distractors in healthcare environments. Drahota (Drahota et al., 2012) conducted a Cochrane review and explored the effect of several positive distractors on health-related outcomes, such as aroma’s, audiovisual distractions, decoration (i.e., colours), and music. However, they found that only the intervention music may positively influence anxiety, and it remained unclear whether the effect was due to distraction or due to another explanation, such as reduced noise. Other

studies showed that the use of nature elements can reduce anxiety, and results suggest that a mediating variable is part of this relationship (Dijkstra et al., 2008; Nanda et al., 2011; Ulrich, 1981; Zijlstra et al., 2017). However, a recent study (Zijlstra et al., 2024) did not confirm the positive effect of positive distraction on anxiety reduction in inpatient rooms.

Need for understanding psychological mechanism on stress reduction

As Ulrich (1991) stated, the Theory of Supportive Design may not be comprehensive. Not all design features and strategies seem to fit within the scope of this theory. For example, design elements such as colour or materials may influence the psychological well-being by allowing people perceive the environment as more pleasant. Previous studies have shown that patients experience less anxiety when they perceive the room as more pleasant or attractive (Dijkstra et al., 2008; Zijlstra et al., 2017, 2024). However, it remains unclear which design features cause people to perceive the room as pleasant or unpleasant and how this differs from positive distracters in this theory. Within the field of environmental psychology, Kaplan (1987) discussed that outdoor environmental features as complexity, coherence, mystery, and legibility can predict what people perceive as preferable. And Evans and Mitchell McCoy (1998) introduced a taxonomy of five indoor environmental dimensions that may influence anxiety, namely stimulation, coherence, affordances, control, and restorative. In essence, understanding which design features cause people to perceive an inpatient room as pleasant or unpleasant is crucial for understanding how different design features interact with one another and together form their overall perception. As supported by the literature review of Elf et al. (Elf et al., 2017), there is a need for an inclusive theoretical foundation on how the built environment of the inpatient room can reduce stress.

Hence, the aim of this current study was to gain a better understanding of which design elements can affect sense of control, social support, and positive distraction, and gain more understanding about the mediating variables related to anxiety-reducing effects of the physical inpatient room design.

METHODS AND DATA

This study is based on a qualitative approach. The consolidated criteria for reporting qualitative research (COREQ) were used as a guideline to report the data (Tong et al., 2007).

Design

Data of this study were collected as part of a larger online survey with a sample of 558 participants. All participants were exposed to a 3D simulation of an existing inpatient room through a combination of video, images, and descriptions of the room. The aim of the previous study was to compare anxiety in a virtual existing single-bed inpatient hospital room with three virtual redesigns of this room. Participants were told that the aim of this study was to improve inpatient rooms and that we were interested in their experiences and opinions about an inpatient room. All outcome measures were self-reported by participants. See Zijlstra et al. (2024) for a more detailed description of the study.

Participants

Participants in this study were recruited through e-mail. Participants were included when they met the following inclusion criteria: 18 years or older and hospitalized in the Netherlands in their lives for at least one night. Patients were excluded when they were hospitalized for the last time: (1) at a psychiatric ward, (2) at a rehabilitation clinic, (3) for the birth of their child, because this type of healthcare is often delivered at other facilities in the Netherlands and the length of stay differs too much from the average length of stay in a Dutch hospital of 4.5 days. Participants gave their written informed consent.

A total of 539 participants filled in the open-ended questions in the questionnaire. The backgrounds of these participants are shown in Table 1.

Table 1 Characteristics of study participants (n = 539)

Participant characteristics	Frequency (%) / Mean (SD)	
Gender		
	Male	268 (50%)
	Female	263 (49%)
	Other	6 (1%)
Age (mean, SD)		67.0 (9.7)
Ethnicity		
	Dutch	132 (96%)
	Other	5 (4%)
Education		
	Low	2 (0%)
	Middle	251 (47%)
	High	284 (53%)
Work		
	Yes	83 (15%)
	No	454 (85%)
Household		
	Single	128 (24%)
	Family	375 (70%)
	Other	34 (6%)

Data collection

The data collection was conducted between June 24, 2022, and August 22, 2022. In the questionnaire participants were asked three open-ended questions: "Can you briefly describe in your own words what you do appreciate about the hospital room shown?", "Can you briefly describe in your own words what you do not appreciate about the hospital room shown?", and "What would the ideal hospital room look like for you? For example, do you have any wishes for the ideal hospital room?"

Data analysis

Direct content analysis was conducted to analyze the data. Existing theory was used to start identifying variables as initial coding categories. The first and second author coded the open-ended questions separately. Both coders categorized all codes in predefined categories (sense of control, positive distraction, social support) and new categories and subcategories that were derived from the data. After the agreement of the initial coding framework, the remaining respondents were coded in phases, until saturation was reached. After each phase the coders critically assessed the codes to check and reach an agreement before continuing. The codes were entered into ATLAS.ti.

Once all codes were identified and clustered in categories, relationships between categories (i.e., causal network) were sought to identify themes. These relations between categories were developed through a logical interpretation of the relationships between codes within the participant's quotation (Miles & Huberman, 1994).

Ethical considerations

According to the Dutch law for medical research involving human subjects (WMO), a waiver for ethical assessment was provided by the Medical Ethical Committee of the Medical University of Groningen

on February 10, 2025 (METc2025/072). The study was conducted according to the Declaration of Helsinki.

FINDINGS

The analysis revealed four key themes: experiencing positive distraction, experiencing a pleasant atmosphere, experiencing access to social support, and experiencing sense of control. The analysis revealed that patients experienced positive distraction, a pleasant atmosphere that calms, sense of control, and access to social support. These themes can potentially reduce anxiety. The themes and categories are presented in Table 2. The findings are presented according to the themes.

Table 2 Overview of themes and categories of patient experiences in inpatient room designs

Theme	Categories
Experiencing positive distraction	Artwork, nature, outside view through windows, decoration, positive distraction
Experiencing a pleasant atmosphere	Colours, light, spaciousness, shapes, materials, calmness
Experiencing access to social support	Visitor seating area, rooming-in, social support from fellow patients, social support
Experiencing sense of control	Adjustable interior facilities, windows to the nursing ward, remote-controllable curtains and sunscreens, openable windows for fresh air, user-friendly technology within reach, sense of control

Experiencing positive distraction

Experiencing positive distraction plays an important role during hospitalization in an inpatient room. Artwork played an important role in experiencing positive distraction. Participants described experiencing comfort when there is artwork on the wall. One participant mentioned: "There are soothing and comforting paintings on the wall that I can wander into". In rooms without artwork, participants experienced a lack of positive distraction and suggested adding more artwork and colourful artwork, for example art with flowers or landscapes.

Nature view in or outside the room also played an important role in experiencing positive distraction. Participants experienced a room with a view on greenery as pleasant. One participant mentioned: "Lots of green outside, that's where you want to go after recovery anyway". Conversely, inpatient rooms with a view to other buildings perceived less distraction, as participants missed a beautiful green outside view and missed the movements of animals like birds. Some participants suggested adding plants or flowers in the room, although they recognized this might be challenging in a hospital setting.

Outside view through windows were a source of positive distraction. Participants preferred seeing people walking outside, greenery outside, wind blowing or animals flying. These views helped distracting them from their illness. However, when the view was limited to other buildings, participants felt a lack of distraction.

Decoration within the room also contributed to positive distraction. A pinboard for postcards was much appreciated as it provided a place for personal touches. Participants found it important to have a view of the decoration from their bed. However, the size of the pinboard can be a concern. One participant commented: "*The pinboard is hanging mega-sized in front of the bed. If you don't receive cards, it almost depresses you*". Others described that they would hang up their own items to feel more at ease. Some participants found it disturbing to have a continuous view of a clock in front of the bed.

Experiencing a pleasant atmosphere that calms

Experiencing a pleasant atmosphere that calms played an important role in the impact of the inpatient room design. Participants often described a pleasant atmosphere as warm, calming, home-like, friendly, fresh, happy, or cozy. They appreciated when the inpatient room helped them feel more at ease and relaxed. As one participant noted: *"For me, what my environment looks like and what atmosphere a room has is enormously important. In particular, when I am sick and vulnerable, a pleasant environment helps to make me feel more at ease, have trust and be able to surrender to the situation. For me, these are conditions for mental stability and rapid healing."* Conversely, participants found cold, sterile, uncozy, boring, and clinical atmospheres unpleasant.

Colours played an important role in experiencing a pleasant atmosphere. Participants described positive aspects of colours as very diverse, such as colour differences, soft colours, warm colours, natural colours, happy colours, calm colours, or beautiful colours. For instance, one participant said: *"The colours that are used are calming"*. Another described it as: *"Because of the colours of the walls, the greenery and the sitting area, a calmness emanates from the room."* Many participants also described it as the coherence between colours. On the other hand, participants described the negative aspects of colours as part of the atmosphere, such as dirty colours, cold colours, and monotony in colours.

Light is another important design element. Participants valued sufficient, natural, and ambient light. One participant highlighted: *"Large window, sufficient natural light"*.

Spaciousness had also an important role. One participant noted: *"There is a lot of space, so you don't get the trapped feeling that normally tends to happen"*. However, too much space could feel overwhelming, as another participant mentioned: *"The room and also the bathroom are way too major, making me feel small in such a large space"*.

Shapes and materials also contributed to a pleasant atmosphere. Participants appreciated modern furniture with friendly shapes and pleasant materials.

Experiencing access to social support

Experiencing access to social support was important for many participants during their stay in inpatient rooms. While the privacy of single rooms was appreciated by many, the presence and support of visitors and fellow patients were also important for psychological well-being.

Visitors seating area was an important element for participants to experience access to social support. Participants found it important to have sufficient space and a comfortable place for their visitors to sit and support them inside the inpatient room. A cosy seating area facilitates social support. As one participant noted: *"I miss a comfortable chair for visitors or myself"*. Some participants also suggested to have a visitor's seat outside the inpatient room, such as a sort of day room or living room.

Rooming-in was described as an option for partners to stay overnight and to experience social support. One participant suggested: *"Possibility (especially in long-term admissions) for the partner to stay overnight for special events (such as major surgery, holidays such as Christmas, and the like)"*.

Social support from fellow patients was missed by some participants in the single-bed inpatient room. When participants felt very ill, they tend to prefer a single room for the privacy and quietness it offers. However, when they felt better, the social interaction and support from fellow patients could be beneficial. Some participants suggested multi-bed rooms to experience a sense of support.

Experiencing a sense of control

A sense of control can be enhanced through adjustable interior features. For instance, participants described that a comfortable adjustable chair allows them to watch TV, having conversations, or take naps, depending on how they feel. As one participant noted: *"Lots of opportunities to adjust things to what you are comfortable with at the time."*

Participants also mentioned the importance of having an adjustable TV in the room. This allows patients to watch TV comfortably from either the bed or chair, depending on their position and their visual or auditory needs. One participant suggested: *"TV on ceiling is inconvenient. Ideal would be a TV that can be remotely adjusted to the ideal position."*

Windows to the nursing ward were another feature that contributed to a sense of control. Participants appreciated the privacy of single rooms but also value the ability to connect with the ward. One participant explained: *"As well as a view of the corridor so that you can notice the sounds of the ward and hear that someone is coming, rather than being surprised by visitors, just as the door opens"*.

Remote-controllable curtains and sunscreens were essential to control daylight. They suggested: *"That you are able to control everything from your bed, without looking for help. Like controlling your bed, light, blackout, etc."*. Participants felt loss of control with automatic sunscreens.

Openable windows for fresh air were another feature that participants appreciated. One participant noted: *"The windows can open and that can be very nice, but then there also has to be a good system that can keep pests like mosquitoes out"*.

User-friendly technology within reach was crucial for having a sense of control. Participants found it important to have accessible electrical outlets and charging options for their devices, such as USB ports. One participant suggested: *"That you can also easily see and control things"*.

DISCUSSION

The aim of this study was to gain more understanding of the underlying mechanism of stress-reducing effects of the physical inpatient room design. Findings of this study suggest that the supportive role of design goes beyond sense of control, positive distraction, and social support, and suggest including the role of a pleasant atmosphere (Fig 1).

As expected, patients describe the role of sense of control. Sense of control is more than just offering the possibility to control physical- and social environmental stressors. Participants appreciate the availability of adjustable interior features, windows to the nursing ward that also can be blocked, remote-controllable curtains and sunscreens, and openable windows. An important aspect of sense of control seems to be the actual ability to use facilities to increase sense of control, such as user-friendly technology within reach. This might be an explanation that sense of control not always reduces anxiety (Zijlstra et al., 2024). Although patients have the option to change aversive stimuli in- or outside the inpatient room, they do not always feel able to influence it themselves. For example, because they are confused of all the options or are unsure how to use the remote-controller(s). This adverse effect may suppress the effect of sense of control on anxiety reduction in previous studies (Andrade et al., 2017; Zijlstra et al., 2024).

It was also found that design elements play an important role in experiencing social support. This is in accordance with the Theory of Supportive Design (Ulrich, 1991). Participants highlighted that a comfortable seating area for visitors can facilitate access to social support of family and friends. For some participants, also a comfortable sleeping area is desirable to facilitate access to social support. Although this study was focused on single-bed rooms, many patients desired the company and social support from fellow patients which is in accordance with other studies (Maben et al., 2016; Nash et al., 2021). Findings suggest that these preferences might depend on the patient's medical condition and related recovery.

Also, different design elements seem to play a role in experiencing positive distraction. Participants prefer to look at something to feel at ease. These findings have practical implication for inpatient room design and suggest that incorporating artwork, nature, outside view to windows, and decoration (i.e., pinboard) can provide positive stimulation and act as positive distractors. For example, it was noted that artwork with nature was experienced as soothing and a window with a view to greenery were appreciated. These results are in accordance with other studies that nature, in the form of artwork or views, are experienced as beneficial by patients (Nanda et al., 2011; Ulrich, 1981; Zijlstra et al., 2017).

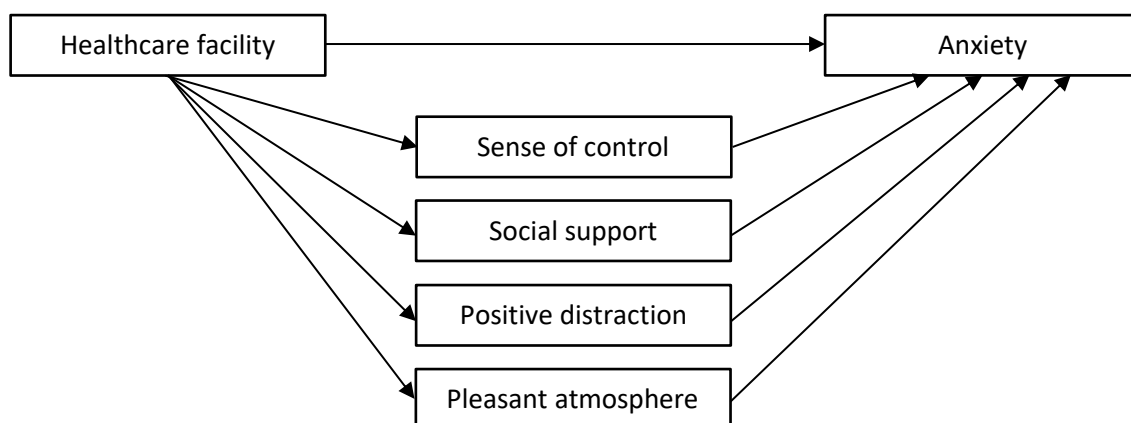


Figure 1. New suggested conceptual model built on the Theory of Supportive Design by Ulrich (1991). Source: Authors' own work

In addition to the theory of Ulrich (1991), findings suggest the important role of experiencing a pleasant atmosphere. The atmosphere is more about the feel of a room rather than focusing on attention on design elements as part of positive distraction (Ulrich, 1991; Webb et al., 2012). These results carry practical implications for design, highlighting the importance of elements such as colours, light, spaciousness, shapes, and materials. The philosopher Böhme (2013, p2) described that atmospheres have a character, that is “the way in which it communicates a feeling to us as participating subjects”. The atmosphere in a room may be experienced as a holistic experience of different design elements (Mobach, 2007). For example, the use of different colours, materials, and lighting which creates an overall atmosphere of calm. These findings appear to align with ‘coherence’ in the preference matrix of Kaplan, which is “the degree to which the scene hangs together” (Kaplan, 1987, p10). The findings are also in line with Böhme (2013) and suggest that the experienced atmosphere is one in which single elements come together and is something between the subjects (i.e., patient) and the object (i.e., inpatient room design), which makes them intangible.

The distinctions between the four mediating concepts can be helpful in understanding the impact of the inpatient room design to reduce anxiety. In addition, it also seems that the four concepts may share a number of design features despite the differences in their goals.

LIMITATIONS AND FUTURE DIRECTIONS

There are some limitations to be considered in this study. We studied the experience of participants in virtual single-bed inpatient rooms. A limitation of this study is that we focused on single-bed inpatient rooms and participants were not hospitalized at the moment of asking. Further research should clarify what real patients experience in different room settings during real-life hospitalization.

Moreover, in this study a large sample size of former patients was included, but only a small number of open questions, as part of a larger questionnaire, were analysed. Further understanding of the psychological mechanism, and specifically the role of a pleasant atmosphere, in an inpatient-room setting is needed. Further research with in-depth interviews may be helpful to better understand the role of a pleasant atmosphere in an inpatient room setting.

Moreover, this research focused on the theory of supportive design. While this theory provided valuable insights into the relationship between the inpatient room design and anxiety, other theoretical perspectives from the field of environmental psychology, philosophy or neuroaesthetics remain unexplored (Chatterjee & Vartanian, 2014; Evans & Mitchell McCoy, 1998; Kaplan & Kaplan, 1989; Kaplan, 1995). Further research is needed to understand whether an integration of these theories might be achieved.

Finally, findings of this qualitative study suggest the important role of sense of control, social support, positive distraction, and a pleasant atmosphere. Further empirical research (e.g., quasi-experimental studies or randomized control trials) is needed to test the relationship between design features and patient anxiety, and to determine whether this relationship is mediated by these four concepts.

CONCLUSIONS

The design of inpatient rooms play an important role in the experience of patients. This article emphasizes the role of sense of control, social support, and positive distraction in an inpatient room setting. Additionally, the present study identified a fourth concept: a pleasant atmosphere. Findings suggest that design elements such as colours, light, spaciousness, shapes, and materials can enhance a pleasant atmosphere, and that this may potentially reduce patient anxiety. These findings help facility managers, decision makers, policy makers, and designers to achieve solutions in meeting the needs of patients. They can apply the findings for example in mock-ups and in the design of new wards. To fully understand the psychological mechanism between inpatient room design and anxiety, a deeper understanding of potential mediating concepts and more empirical studies are needed to develop an inclusive theoretical framework.

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Reconciling University's Strategic Workspace Goals: How End-Users Influence the Resulting Design

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ABSTRACT

Background and Aim. This article examines the implementation of a university's strategic workspace goals through participatory design processes. It evaluates the goals and the university-level participatory approach and compares several unit-level participatory processes within a single building project. The study aims to identify the influence of end-user communities on the participatory design process, their engagement, and the alignment of outcomes with the strategic goals.

Methods and Data. The study investigates material from campus development project at a Finnish case university. The findings are derived through an inductive process of qualitative content analysis. The material comprises project documentation and 13 semi-structured interviews with various stakeholders, including management and designers.

Results. The university's strategic campus development incorporated both business- and cost-driven approaches, with financial saving emerging as priority. Despite formal participation strategies, early-stage decisions led to a predominantly solution-driven implementation. Unit-level participatory processes varied markedly in end-user involvement, resulting in inconsistent integration of strategic goals with end-user perspectives. These findings underscore limitations in the university-level spatial change process.

Originality. Participatory processes in academic workplace transformation remain underexplored. This study contributed by comparing university- and unit-level participatory approaches, revealing variations in change management, spatial planning, and user involvement.

Practical Implications. The results support improved end-user engagement in university development processes by emphasising the importance of early-stage involvement in goals setting and the need for adequate human resources to facilitate participatory processes.

Type of Paper. Full Research

KEYWORDS. academic workplace, end-users, engagement, participatory design process, strategic goals

INTRODUCTION

Universities have evolved through societal changes throughout their existence, and the campuses, the spatial forms of universities, have represented the change (Benneworth, 2014). One of the recent trends influencing campuses has been university mergers (Tienari et al., 2016) that, together with financial pressures and new ways of working, have led universities to reduce their footprint and retrofit existing facilities (den Heijer, 2011; Marmot, 2014). Academic work environments have been introduced with various open and flexible workspace models, such as activity-based offices (Berthelsen et al., 2018; Häne et al., 2020; Indergård & Hansen, 2024; Nooij et al., 2023) and a focal driver for implementing them has been cost reduction (Nooij et al., 2023). The benefits have been, e.g., increasing interactions and providing flexibility for future changes (Häne et al., 2020). However, the literature seems contradictory on whether activity-based environments are suitable for academic work (Häne et al., 2020; Marzban et al., 2023; Nooij et al., 2023).

As universities have adapted premises to the user needs, research on academic workplaces has also been growing (Indergård & Hansen, 2024), especially concerning the outcomes of change processes and end-user perceptions (Berthelsen *et al.*, 2018; Häne *et al.*, 2020; Indergård & Hansen, 2024; Nooij *et al.*, 2023). However, not only the end-product, but the change process itself influences end-users' satisfaction towards the resulting work environments (Breutner & Roth, 2024). According to Boge *et al.* (2017) involving end-users in early-phase planning is among the most important factors for long-term value creation. While organisational changes and spatial change initiatives have long been debated (e.g., Skogland & Hansen, 2017), the university organisations' workspace initiatives and participatory processes in academic contexts require further research.

The aim of this study is to evaluate a university's strategic workspace goals and end-user engagement process to define if the goals are aligned with end-users' perspectives, and whether the goals are achieved through participatory processes. The article examines the implementation of a university's strategic workspace goals through the lens of a single building project. Firstly, the selected case provides a tangible example of how strategic objectives are translated into practical design solutions. Secondly, the comparative setting enables to reveal variations in change management approaches, spatial planning practices, and end-user engagement strategies and in turn, how end-users, here academic units functioning within a faculty, influence the participatory process and the strategic goals. With this stepwise comparison, the study enables a deep and bounded analysis of the participatory and building's transformation processes. The findings benefit research on change management and practice in formulating future participatory processes within academic environments. The main RQ is: *How are a university's strategic workspace goals implemented in a building transformation project?*

LITERATURE STUDY

As previously noted, university organisations have increasingly transformed their workspaces. Today, a variety of office types – including open, flexible and activity-based work environments (ABW) can be found within universities, with mixed outcomes and user experiences (Häne *et al.*, 2020; Indergård & Hansen, 2024; Nooij *et al.*, 2023). As in other knowledge-intensive environments, academic workspaces should support both collaborative and individual work (Indergård & Hansen, 2024). These strategic spatial changes are often driven by the dual aim of improving accommodation efficiency—primarily through cost reduction—and enhancing effectiveness by delivering greater value to end-users (van Ree, 2002). Similarly, Beckers *et al.* (1994) identified two core motivations behind workplace strategies: a cost-driven approach focused on financial savings, and a business-driven approach aimed at challenging conventional practices and exploring new ways of working.

Moreover, the success of spatial change is shaped by the implementation strategy. According to Beckers *et al.* (1994), this can be either solution-oriented—seeking to persuade employees to adopt a standardized workplace model—or process-oriented, involving end-users in the co-creation of diverse workplace solutions tailored to specific needs. Petrulaitiene and Jylhä (2015) further categorise workplace concept changes into four drivers: 1. external economic or social factors, such as economies of scale and aging society, 2. technological developments, 3. changes in business processes, and 4. changes in organisational structure.

Skogland and Hansen (2017) emphasise that the change management processes are inherently complex and multi-faceted. For spatial strategy to succeed, it must be embraced across all organisational levels and structures. Failure to adopt the strategy or misinterpretation by end-users can jeopardize the initiative. Therefore, successful change requires continuous development and evaluation throughout the implementation process. (Skogland and Hansen, 2017.) Wäistö *et al.* (2024) found that the strategy implementation has limited influence on the workspace design outcomes. However, successful design requires consideration of both organisational and human factors (Wäistö *et al.*, 2024).

Organisational relocation entails multiple impacts, including relocation costs, operational disruption, employee reactions to change, satisfaction, and altered work practices (Christersson & Rothe, 2012). Boge et al. (2017) highlight that early-phase planning is critical for a building's usability and lifetime value creation. Van der Voordt and Jensen (2023) emphasise the importance of user involvement in the design process and change management during implementation for fostering healthy workplaces that support productivity. Similarly, Breutner and Roth (2024) found that change processes significantly influence end-user satisfaction with the resulting work environments.

End-user participation in the design process can be organised in various ways, depending on whether users are regarded as 'subjects' or 'partners' (Sanders & Stappers, 2008). According to Sanders and Stappers (2008), the early design phase is particularly ambivalent, as future users and their needs are considered. Horelli (2002) categorises user-involvement in participatory planning into four Indicative Levels of Participation: 1. Information, 2. Consultation, 3. Partnership, and 4. Community control. The first level reflects a passive user role, aligning with Sanders and Stappers' (2008) 'users as subjects', while the fourth represents active engagement, consistent with 'users as partners'.

METHODS AND DATA

This study examines strategic workspace goals and participatory processes through a single building case study. Case studies are typically qualitative (Yin, 2014), and this study investigates the phenomena by discovering patterns of association in inductive analysis of qualitative data (Blaikie, 2010). The case is a work environment change process in a building retrofit project within a larger university campus development process. The case building was selected due to its status as the first completed project within the framework of the campus development initiative. Focusing on this single building project (BP), the paper focuses on the participatory design processes, examining how end-users influence both the process and its outcomes, as well as the end-users' engagement with broader campus development initiatives. The building's internal comparative setting focuses, e.g., on spatial changes across different units. This focused approach enhances the research's validity by situating all actors and interventions within a shared architectural and organizational framework, constituting the case as a microcosm for assessing broader strategic and operational dynamics. The units selected for review were chosen due to their location on the same floor in the case building making them contextually comparable and because they frequently emerged from the interviews.

The material consists of two primary datasets: a. campus development documents and b. semi-structured interviews with key stakeholders. These datasets enable a comparative analysis between the stated strategic goals and guidelines (dataset 1) and stakeholder experiences (dataset 2). To examine the stated strategic goals, openly accessed campus development documents were collected from the university intranet: e.g., the Campus Development (CD) Strategy (2020) and the Facilities Programme (2021). These documents were analysed through qualitative word frequency analysis. The first dataset also includes supplementary material produced and collected by the CD project such as responses to a 2021 user survey aimed at broad university community participation prior to any building project, as well as official statements from academic management bodies (e.g., faculty councils) and employee associations (e.g., professors union) regarding the Facility Programme.

The second data set focuses on stakeholder experiences. 13 semi-structured interviews were conducted with key stakeholders. By using snowball sampling, interviewees were selected from various stakeholder groups regarding the BP to ensure a comprehensive understanding of the project's objectives, processes, and outcomes. Interviewees include university and faculty management, end-user representatives (science and management fields), campus development and facilities experts, design experts (architects and engineers), and a property owner. The interviews were conducted in summer-fall 2024, when BP had been completed, and end-users had recently moved to the retrofitted premises. The interview question set included three main topics: 1. the nature, productivity and effectiveness of academic work; 2. the campus development process and building projects: perceived goals, values, process, user participation, and data collection; and 3. the outcome and space utilization. This paper focuses on second and third sets. The interviews lasted between 45

and 70 minutes and all interviews were transcribed. The data sets were analysed through several iterative rounds in Atlas.ti by two researchers. The process comprised three main phases. The first phase began in fall 2024 with independent analysis of the interview data (dataset 2) in Atlas.ti, followed by joint analysis rounds with a third researcher. This phase focused on the building project goals and outcomes. The initial findings informed the second phase, which consisted of collecting and analysing the CD documents (data set 1) in Atlas.ti. The third phase consisted of merging the findings from the two previous phases. These three steps led to the following sub-RQs:

1. What were the strategic goals of the campus development project?
2. How was the participation organised in campus development and in a building project?
3. How were the strategic goals for the work environments achieved in a building project?

RESULTS

The results are organised into two main parts and four sections. The findings presented in the two first sections focus on the strategic workspace goals and the end-user engagement process at the early stages of the campus development. The last two sections focus on the building project goals and related end-user engagement.

Result section 1: University's Spatial Development Strategy

The first section responses to the sub-RQ 1: "What were the strategic goals of the campus development project?". The findings are based on both the university's strategic-level documents and on the stakeholder interviews and are mirrored to the Becker et al.'s (1994) framework of business- vs. cost-driven approach and process- vs. solution-driven implementation strategies.

Table 1 presents three main strategic goals in the CD strategy and the Facilities Programme (FP): a. economic, b. social and c. ecological, which all are intended "*to support university daily life and core activities*". The economic goal emphasises financial savings through space reductions and increased efficiency. The social goal includes the aim to support, e.g. workplace well-being, community development and synergy benefits. Ecological goal aims to improve occupancy rates and to achieve carbon neutrality.

The cost-driven approach is emphasised in both the CD Strategy and the Facilities Programme, as reflected in the increasing prominence of related aspects (Table 1). The interviewees found all three goals important but also emphasised the cost-driven approach to be the most significant to influence the BPs. While interviewees acknowledged the social and ecological goals, they were only few mentions on, e.g., ecological responsibility or fostering community interaction.

Table 1 The appearance of strategic goals in CD Strategy and Facilities Programme

Identified goal	Appearance in the CD Strategy	Appearance in the Facilities Programme	Percentual change in appearance from CD to FP stage
Economic	18	319	1672%
Social	134	268	100%
Ecologic	16	68	325%

Figure 1. places these goals along two axes: cost- and business-driven approaches (X-axis) and solution- and process-oriented implementation strategies (Y-axis). Economic (ECN) and ecologic (ECL) goals, are interpreted as cost-driven and implemented through solution-oriented strategies, primarily via space reductions and ABW. Social goals (SO) are viewed as more business-driven as they are intended for renewal of the organization, but with solution-oriented implementation strategies of ABW and more efficient space use. However, other means to pursue synergy benefits, e.g., strategic

co-location of the units is not visually communicated. Workplace wellbeing is additionally framed as a more business-driven approach with process-oriented implementation due to possibilities of the BP specific participatory processes.

Although CD documents acknowledge the diverse needs of units and users, they predominantly reflect a solution-oriented strategies. Workspace goals are based on ABW, increased sharing practices, and multi-use spaces, indicating substantial changes to existing partial an operational model. The quantitative goals, such as financial initiatives, are communicated more clearly than quality ones, such as workspace design. For example, the visual FP documents demonstrate different proposals of relinquished buildings or building parts, faculty relocations, and their economic impacts. While they reference underlying values, such as existing special facilities, cultural and historical values, constraints of certain buildings, and campus synergies, they omit current significant places for the campus community. The FP's reduction versions were assumingly tested using ABW measures as a strategic goal, suggesting a solution-oriented approach that either overlooks end-user needs or fails to communicate their implications in the planning documents at a strategic level. Although both interviews and CD documentation addressed the development of new practices and the renewal of space utilisation principles, changes in operational practices and spatial use were primarily driven by predefined spatial solutions and economic incentives, rather than emerging originally from the development process itself.

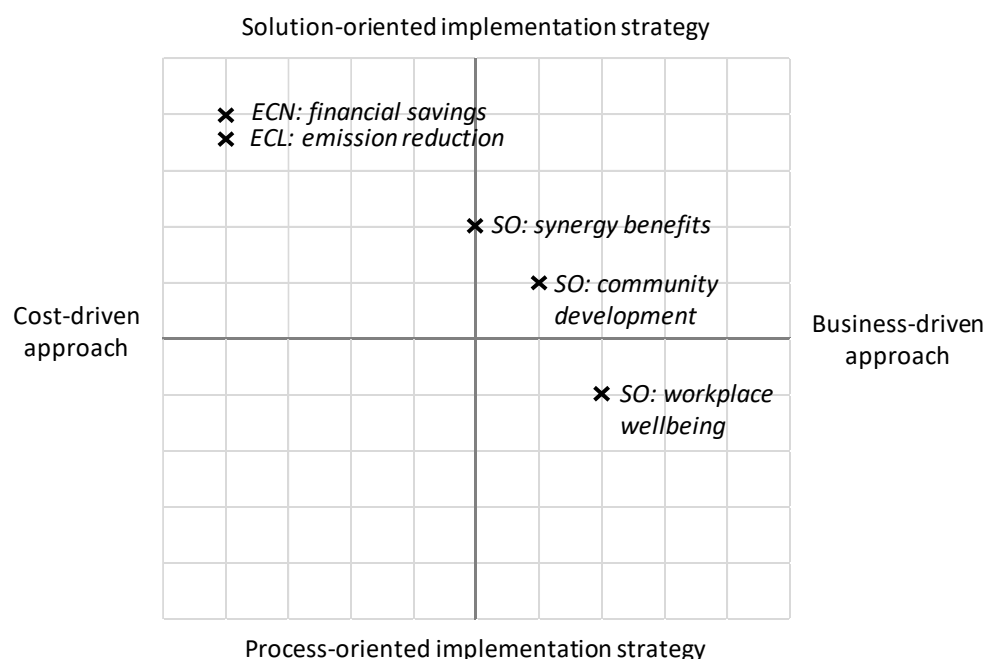


Figure 2. University's Spatial Development Goals. Source: Authors' own work.

Result section 2: End-user Engagement in the Early Stages

This section discusses how the university community was involved in defining the strategic goals of CD. Thus, responding to the first part of the sub-RQ 2. "How was the participation organised in campus development and building retrofit projects?".

All strategic documents emphasise the implementation of participatory processes in building projects to "achieve user-centred environments" and "engage users to emerging new space solutions and operational models". However, CD appears to have organized numerous user participation activities prior to BPs. Figure 2 illustrates the timeline of CD document publications and participation events, revealing that both main documents were published prior to the first instance of end-user involvement. The goals of CD seem to have been defined primarily by experts and university leadership.

In 2019, during the early stages of CD, end-user engagement was conducted through data collection methods, such as, questionnaires, interviews, and space utilization observations. Following the publication of the FP's work environment goals, end-users' participation in 2021 took two main forms (Figure 2): first, a survey of generic post-COVID end-user needs; second, a request for statements from the university community regarding CD's main documents involving 1) end-users, 2) academic administration and councils, and 3) representative groups.

In 2022, Community Expert Groups were established to define the university community's generic end-user needs. The groups operated within the boundaries set by the FP, whose strategic goals had already been defined but not visually communicated. Based on the analysis, the impact of participatory measures on the FP remains unclear. It was not possible to determine whether the 2021 survey or the 2022 community expert groups influenced the implementation of strategic goals.

Overall, a discrepancy appears within the CD's documentation, which simultaneously promotes solution-driven strategies and process-oriented implementation. For instance, the feedback CD collected from end-users in 2021 indicates that a major concern within the university community was the participation strategy itself, as well as the CD's impact on work communities, cultures and core activities. Additionally, end-users expressed concern over CD documents not presenting visually any work environment solutions over the lack of visual representation of campus work environment solutions or building plans in CS documents, which hindered their ability to assess the implications of each CD strategic goal.

While a cost-driven approach dominates the strategic documents and was emphasised by interviewees, the 2021 CD survey reveals that the end-user prioritised business-driven goals. Specifically, they valued support for the university's core activities and alignment of unit locations with future needs. In contrast, financial objectives were considered least important by end-users.

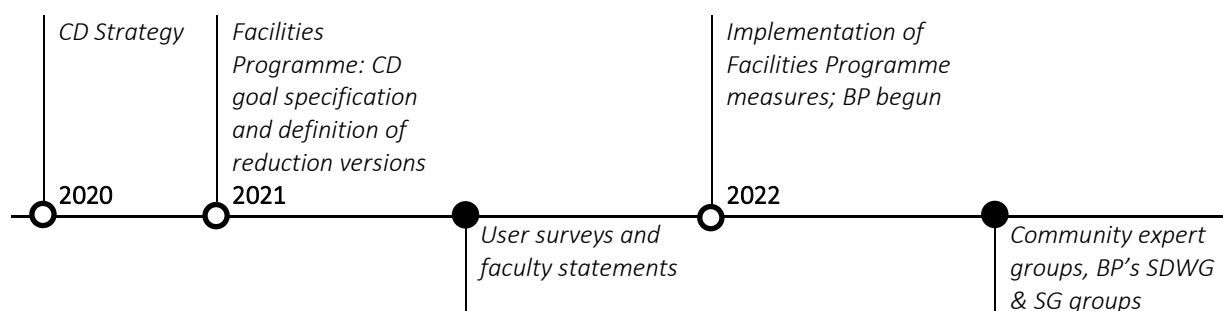


Figure 2 CD process and university community participation. Source: Authors' own work

Result section 3: Goals of the Building Project

This section evaluates the presence of CD's strategic goals within the BP project, drawing on interviews and BP documentation to partially address sub-RQ3: "How were the strategic goals for the work environments achieved in a building project?".

Interviews suggest that no explicit strategic goals were set or discussed for BP. Instead, end-user units articulated their own objectives, such as fostering community and increasing informal encounters. Nevertheless, CD's workspace strategy emerged in the interviews through three distinctive attitudes. First, a defensive stance was observed among end-user representatives who opposed CD's workspace goals, emphasising the importance of private office using terms like "individual" or "personal". Second, a contemptuous attitude was expressed by interviewees who dismissed the demands for single-person offices, referring to them as "cells" or "booths", and were defending ABWs. Third, a positive attitude was evident among those open to change and new spatial solutions. These interviewees acknowledged the diversity of end-users needs and noted that ABWs are not universally applicable or optimal.

Result section 4: Participatory Processes and End-user Engagement with Strategic Workspace Goals

This section addresses the latter part of sub-RQ2: “How was the participation organised in campus development and in a building project?” and partially responds to sub-RQ3: “How were the strategic goals for the work environments achieved in a building project?”. The findings are analysed in relation to Horelli’s (2002) levels of participation and Sanders & Stappers’ (2008) user roles.

Section 4.1 Managerial Organisation of Participatory Processes

The CD documents state that all university building projects are to be implemented through similar participatory processes. In the BP, participatory was meticulously organised into three main participatory groups to manage the process. Table 2 outlines these groups and their stakeholder representatives, based on the interviews and CD documentation.

First, the “Space Development Working Group” (SDWG) was tasked with co-developing spatial solutions and representing end-users from each involved unit (units being administrative entities under faculties). CD documents describe end-user representatives as the link between the SDWG and their respective unit. In the BP case, four units from two faculties were presented.

Second, the “Steering Group” (SG) oversaw and guided the SDWG and approve architectural plans. Third, the “Faculty Campus Development Group” (FCDG) played a preparatory and informative role, regularly addressing process and spatial solutions related to BP.

Due to the scale of the BP and the number of units involved, a fourth group was formed. The SDWG was subdivided into three Co-Development Groups (CoDG) by faculty and unit to address unit-specific concerns more effectively. . However, representatives from CD and facility services were often unable to participate due to time constraints. Interview data revealed three distinct unit-specific processes with varying manners of end-user participation: a) A.1, b) A.2, and c) B.1.

Table 2 The main participatory groups and stakeholder representatives. Source: Authors’ own work

Group	CD representatives	Faculty management representatives	End-user representatives	Architect / Expert representatives
SDWG	x	-	X	x
SG	x	x	-	x
FCDG	x	x	X	-
CoDG	-	-	X	x

The decision to divide the SDWG into CoDGs within the BP enabled unit-specific variation in the implementation of participatory processes which later influenced the resulting workspaces. The three distinct processes also differed also in terms of the end-users’ readiness to change, engagement, and attitudes toward CD. Although CD Strategy had predefined workspace goals, the separation of unit-specific participation highlighted varying degrees of alignment with strategic objectives, particularly regarding time- and activity-based work environment and shared use of spaces.

Interview data indicates that unit A.1 was receptive to new space solutions and actively engaging with the process. In contrast, units A.2 and B.1 demonstrated greater resistance, with low readiness for change and limited engagement with CD’s workspace goals. These units expressed a strong preference for traditional spatial arrangements, such as private, single-person offices.

Furthermore, , the trajectory of the BP process appears to have been shaped by the roles and status of the end-user representatives. In unit A.1, the representative was a researcher and work environment

specialist with a proactive attitude and relevant expertise. In unit A.2, the original representative was replaced early on by the head of the unit, as the initial representative was either unwilling or unable to engage with the complex and managerial scope of the project. Unit B.1 had five representatives—likely due to its size, comprising of both research and teaching staff.

Section 4.2 Variations in Data Collection within Participatory Processes

According to the documentation, each BP process utilised unit-specific preliminary data to identify end-users needs, including number of users, time profiles and work profiles and architects employed as a basis for the initial draft plans.

The differentiated processes appear to have influenced the data collection as well. Once SG and SDWGs were established, all three units operated with considerable autonomy in identifying user needs and organising participatory processes. Unit A.1 adopted a partnership or community-control approach, collecting input through surveys and interactive discussions to redefine spatial needs and work practices beyond habitual preconceived assumptions. This unit aimed to ground decisions in existing research and knowledge. In contrast, units A.2 and B.1 followed a consultation approach, without joint discussions. In A.2 unit, each employee was asked individually about their personal needs and working habits. Similarly, B.1 unit conducted independent user needs assessments based on conventional spatial needs, such as private offices.

Section 4.3 Resulting Workspaces and Strategic Goal Alignment

This section evaluates whether the BP workspaces meet either the strategic goals or end-user satisfaction. The process and outcome of A.1 unit appear relatively efficient and successful. Final plans were iterated collaboratively between the architect and the end-users, with a shared motivation to explore new ways of working. The resulting work environment aligns with all strategic goals while accommodating end-user preferences. The layout entails both ABW with hot-desking, shared-use rooms and desks, and some individual offices as well. Interview data suggests end-users are satisfied with the outcome.

In contrast, unit A.2 followed a more dichotomous process. Although the architect initially drafted plans based on the needs assessment, the proposal did not meet the end-users' request for individual offices. Through further co-development the unit's needs were eventually reconciled with economic goals. The final layout includes more individual offices and fewer ABW spaces than A.1, along with some shared spaces. However, the lack of sufficient meeting rooms—due to reduced allocated space, and the prioritisation of single offices—resulted in only partial alignment with strategic goals and mixed end-user satisfaction.

Unit B.1 proactively produced preliminary user needs data, but end-users perceived the allocated space as insufficient. The unit independently conducted time-intensive planning process, prioritising individual offices, and submitted its proposal to the architect. Interviewees noted strong resistance to change, which led to inflated space demands and the rental of an additional floor—ultimately failing to meet the CD project's economic and workspace goals. From end-user's viewpoint, the process was also unsuccessful. During the construction phase, B.1 temporarily relocated to facilities featuring more ABWs and shared-use spaces. Their experience was positive, prompting a request to either remain in the temporary space or retrofit the newly retrofitted permanent premises accordingly. Neither request was granted.

DISCUSSION

The first part of the study addressed sub-RQ1: *“What were the strategic goals of the campus development project?”*. The identified main strategic goals—economic, social, and ecological—align with the triple bottom line perspective for organizational success (Christersson & Rothe, 2012). These goals reflect both the cost- and business-driven approaches (Becker *et al.*, 1994), with strong emphasis on the economic and quantitative aspects, which are more readily measurable (Christersson and Rothe, 2012). While the cost-efficiency, such as space reductions, dominated both CD documents and

interview data, business-driven values, such as unit location and support for future needs, were important for the university community. However, these were not adequately reflected in the BP's workspaces, where financial savings were perceived as the primary objective.

All four organisational workplace change concepts identified by Petrulaitiene and Jylhä (2015, p.261) appear to underpin CD's workspace goals. External economic factors were the most influential. Technological developments, particularly hybrid work modes, were discussed but had mixed influence on BP outcomes. Although no major changes in business processes were evident, the university merger—the initial driver of CD—altered organisational structure, yet its strategic impact was minimally reflected in the goals.

Sub-RQ2 asked: "How was the participation organised in campus development and in a building project?". Initially, the implementation followed a solution-oriented strategy, shifting toward a more process-oriented approach during the BP phase. Despite various forms of stakeholders and end-user engagement, early participation remained at the levels of information and consultation (Horelli, 2002), with workspace goals defined prior to meaningful input. Higher levels of participation – partnership and community control (Horelli, 2002) – emerged only during BP phase. The solution-oriented implementation strategy aligned with both cost-driven and business-driven approaches but occasionally conflicted with process-oriented implementation, limiting effectiveness. Findings suggest that timely and meaningful participation throughout the process could have improved end-user engagement with strategic goals.

Sub-RQ3 asked "How were the strategic goals for the work environments achieved in a building project?". The division into CoDGs enabled unit-specific processes that shaped end-user engagement and influenced alignment with strategic goals. A critical success factors seems to be related with what type of needs assessment data is collected, who collects it and in what phase. While unit-specific processes enhanced co-development and end-user engagement, they also reduced interaction with other stakeholders, potentially affecting achieving strategic goals. Involving a community or change management expert could improve the co-development process and foster mutual understanding between architects and users.

The findings highlight a clear contrast between lower levels of participation—characterized by one-way communication—and higher levels involving co-development and collective reflection on current and future needs. Active end-user involvement is essential to ensure that their needs are accurately represented in design outcomes.

The main workspace goals—time- and activity-based environments and increased shared use of spaces—aim to reduce spatial footprint, meet diverse user needs, and enable future adaptability. These goals provide serve a sound strategic foundation for aligning organizational and user requirements. However, conflicting findings on ABW in academic contexts (Berthelsen *et al.*, 2018; Nooij *et al.*, 2023; Toivanen *et al.*, 2023) suggest that campus development may require more nuanced strategic goals or a redefinition of workspace quality.

This study's limitations lie in its single-case design, although it includes comparison of three units. End-user satisfaction with renewed premises was not surveyed, presenting an opportunity for future research. Further studies could also compare other campus development initiatives and contexts, strengthening the case study approach.

CONCLUSIONS

This article reviewed a case university's strategic workspace goals and their implementation in a single building case study. The underlying approaches behind identified strategic goals were both business-driven—aiming, e.g., to renewal of work practices—and cost-driven, with financial savings ultimately dominating during the implementation phase. In addition, the cost-driven approach may have been emphasised because the implementation strategy was solution-oriented in the strategic

development stage and moved towards process-oriented only in the building project stage when all strategic solutions were set.

Effective and timely end-user engagement is vital for developing environments that reflect user cultures and work practices, meet organizational and user requirements, and prevent later conflicts. This involves setting quantitative and qualitative strategic goals with users from the outset. Additionally, the participation process—how, by whom, and with whom it is conducted—must be carefully planned.

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AI DECLARATION

The authors employed Microsoft Co-Pilot to proofread, improve grammar, and summarize expression.

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The Impact of Lighting and Indoor Air Quality Conditions on Students' Comfort and Performance in Higher Education: A 2x2 Factorial Design Approach

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ABSTRACT

Background and Aim. To improve the indoor environmental quality (IEQ) in schools, the Dutch government issued a program of requirements (PoR) "Fresh Schools". This study aims to determine the effect of adopting class A (high IEQ) or B (moderate IEQ) of this PoR on students' comfort and performance. Requirements for indoor air quality (IAQ), indicated by CO₂ concentration, and lighting conditions, defined by horizontal illuminance (HI) at the desktop, were systematically examined.

Methods and Data. In a classroom where specific IEQ conditions were established and monitored, students' perceived comfort and performance were measured using questionnaires. Furthermore, students' cognitive performance was assessed with the Stroop test and their short-term academic performance was measured with a content-related test. Data from 83 students resulting in 285 responses were analyzed using linear mixed model. These responses were distributed across four combinations of moderate and high IAQ and HI levels.

Results. The results indicated that high IAQ levels did not significantly enhance students' perceived IAQ and performance, compared to moderate levels. In contrast, high HI levels did contribute significantly to students' perceived lighting comfort (PLC) and students' cognitive performance, when compared with moderate HI levels. The interaction between the two factors investigated was significant, indicating that the effect of HI levels on outcome variable PLC depends on the level of IAQ.

Originality. The study was performed during a regular academic course which suggests a high ecological validity of the observed effects.

Practical and Societal Implications. Building-services engineers, designers, and facility managers can use these findings when seeking to design appropriate learning environments for future generations.

Type of Paper. Full Research

KEYWORDS. academic performance, carbon dioxide, cognitive performance, horizontal illuminance, indoor environmental quality

INTRODUCTION

This study examines the impact of indoor environmental conditions on students' comfort and academic performance in higher education. Four major factors – acoustic environment, lighting conditions, thermal environment, and indoor air quality (IAQ) – determine the quality of the indoor environmental quality (IEQ) (Frontczak & Wargocki, 2011). Actual IEQ conditions in classrooms influence, among others, students' internal responses, i.e., physiological, emotional, and cognitive responses and their behaviors (Bitner, 1992). In addition, these factors can influence students' academic performance (Wargocki & Wyon, 2017).

When examining the impact of IEQ factors in in-situ settings, students are subject to multiple environmental factors simultaneously (Torresin et al., 2018). Various combinations of multiple IEQ affect students' overall IEQ satisfaction and interactions between different IEQ factors occur. These interactions were observed by Kim and De Dear (2012), who developed a model to determine these interaction effects and the existence of a hierarchy among IEQ parameters in an office environment. These researchers identified two basic IEQ factors, namely temperature and noise level. The correct conditions for these factors are crucial for overall IEQ performance, but they do not necessarily contribute to an improved IEQ experience. Air quality, the amount of light in the workplace, visual comfort related to the lighting, and sound privacy were classified as proportional IEQ factors; the overall occupant satisfaction increases or decreases proportionally to the building's performance impacting these factors; However, this only applies when the correct conditions for the basic factors are met (Kim & de Dear, 2012).

To reveal what is known about the influence of combined indoor environmental factors, Torresin et al. (2018) conducted a systematic review. They report that the number of laboratory studies addressing combinations of different indoor environmental factors is limited, possibly because these studies are time-consuming in terms of experimental design and in terms of expensive facilities that allow simultaneously monitoring and controlling two or more environmental variables. Studies which were evaluated in this study revealed that the most common combination of examined IEQ factors was the combination of thermal and lighting conditions (29%) followed by acoustic (noise) and thermal conditions (24%). Furthermore, no studies were found dealing with the interaction effects of lighting and IAQ conditions, although authors reported a positive effect of lighting conditions (i.e., illumination level) on air acceptability: higher air acceptability level was observed at the highest illuminance (Torresin et al., 2018).

A systematic review performed by Brink et al. (2021), which focused on what is known about the influence of all four IEQ factors on students in higher education, concluded that studies which examined combinations of IEQ in higher educational settings are limited. Authors reported four studies which examined, among other factors, the influence of lighting and indoor air quality conditions (Gentile et al., 2018; Jamaludin et al., 2016; Lee et al., 2012; Yan et al., 2012). However, none of these studies examined the combined influence or interaction effects of lighting and IAQ conditions.

More recently, Yang & Mak (2020) investigated the effects of IEQ factors on students' behavior and their perceptions of those factors. They found that the thermal environmental quality is an essential factor for respondents in university classrooms followed by the acoustic environmental quality, lighting environmental quality, and indoor air quality, respectively. However, these results represent only the order of preferences of students living in Hong Kong, where outside temperature is always relatively high. And although these findings enrich the findings of Kim and De Dear (2012), they did not examine possible interaction effects.

In this context, this study seeks to contribute to the understanding of the main and interaction effects between IEQ factors in higher education. Specifically, this study focuses on the effects of the factors lighting and IAQ. Two different quality conditions for lighting and IAQ were derived from Dutch guidelines for school buildings. These guidelines list three quality classes (A, B, and C) addressing the four major IEQ parameters (RVO, 2021). When building or renovating schools in The Netherlands, school management may choose between quality classes A, B, or C. To support such a decision-

making process, and identify the effect on students' comfort and performance, this study compares quality class A and B requirements for horizontal illuminance (HI) levels in classrooms, i.e. HI 750 and 500 lx respectively, representing the factor lighting and carbon dioxide concentration (CO₂), i.e. ≤ 800 ppm and > 800 ppm ≤ 950 ppm CO₂, representing the factor IAQ.

The objective of this study is to answer the following research question: What are the main and interaction effects of increasing the HI level from 500 to 750 lx and reducing CO₂ concentrations from between 800-950 ppm to below 800 ppm, on students' perceived comfort and performance during a regular academic course? And by doing so, this study provides more knowledge about the effect of simultaneously improving lighting and IAQ conditions on students' comfort and performance in higher education. Additionally, when examining the impact of IEQ factors on students, it is essential to consider individual differences in students' subjective responses to identical indoor environments (Frontczak & Wargocki, 2011). These differences include individual characteristics (e.g., gender, age), building features (e.g., use, spatial qualities), or the outdoor climate, including seasonal changes and therefore daylight entrance and air quality. This study includes relevant individual differences when studying the influence of IEQ factors on students in higher education in the Netherlands.

METHOD

The experiment was performed in the Netherlands from the 20th of November till the 20th of December 2023. In this study, 32 male and 51 female freshmen, aged 19 ± 1.7 , participated in six campaigns, while following their regular academic classes. These first-year students were selected for the study because they were lay persons and not yet versed in building physics. The study was performed in a classroom at the School of Future Environments of the Hanze University of Applied Sciences (UAS), the Netherlands. The classroom's size is 10.64 x 7.04 m, the reverberation time of the classroom is 0.4s at 250-2k Hertz, and the classroom is orientated west-south-west (53.24077N, 6.53106E).



Figure 1a-b Visual appearance of the classroom's interior. The left photo shows the classroom from the lecturer's perspective; the right photo shows the opposite students' perspective. Source: Authors' own work.

To prevent daylight entry during the experiment, the awnings on the outside of the windows were kept closed during the experiment. The classroom was fitted with thirteen ETAP U3352 lighting armatures with a color temperature of 5000K and a color rendering index of 80. The lighting system is equipped with a dimmer and the HI at the lecturer's desk, serving as a reference for the HI levels at all desks, was adjusted to meet the specified value before the start of every lecture. Lecturers were instructed not to adjust the illuminance level during the lecture. Furthermore, the classroom is equipped with a heating, ventilation, and air conditioning (HVAC) system. This system consisted of a combined air handling unit, including fixed plate heat exchangers and F7 filters, with a capacity of 3500 m³/h, which results in a maximum ventilation rate of 16 l/s per person at a maximum of 30

persons. Furthermore, an air-cooled heat pump of 25 kW is installed. Using this system, both air temperature and air quality – indicated by maximum concentration of CO₂ – can be regulated in the classroom by entering the desired values into the control system.

Figure 1a-b shows two pictures of the interior of the classroom with opposite perspectives.

The final study design was approved by Hanze UAS' Ethical Committee (No. T2023.040). Before participating, the students received a general outline of the study and its objective, which was to assess the quality of the classroom. All students who participated in this study signed an informed consent form. The students could end their participation without any consequences and at any time. Nonetheless, none of the participating students requested to withdraw from the study or to have their data excluded. The type of lecture was a tutorial, in which the lecturer gave a presentation about basic management principles. The duration of each lecture was approximately 90 minutes.

Four groups of freshmen and two lecturers (X, Y) participated in the experiment. The lecturers involved gave two consecutive lectures to two groups (A-D). For example, an involved lecturer gave a lecture on Wednesday from 8:30-10:00 a.m. Shortly after this first lecture, the same lecturer gave a lecture from 10:30-12:00 a.m. The lecturers were instructed to give the same lecture both times and were not informed which conditions were created in the classroom.

Before the experiment, students were randomly assigned to a group, initially with approximately 27 students each. All lectures were given from Tuesday to Friday, paired lectures were always on the same day, and approximately at the same time for each group. All four groups were at least once exposed to either of the four combinations of moderate – high lighting and IAQ conditions. To complete the factorial design, all six possible comparisons were included in the experimental design (Table 1). This full-factorial design allows us to examine the main effects of, as well as all interaction effects between the two factors HI and IAQ. Table 1 provides an overview of all conditions evaluated and six possible combinations of the four different conditions examined during the experiment.

Table 1 Overview of study design with 4 groups of approximately 15 ± 5 students and 2 lecturers over 6 runs

Lecture (week)	Condition			
	group A lecturer X	group B lecturer X	group C lecturer Y	group D lecturer Y
1 (2)	IAQ _h ² - HI _m ³	IAQ _m ¹ - HI _m ³	IAQ _h ² - HI _m ³	IAQ _m ¹ - HI _m ³
2 (2)	IAQ _h ² - HI _h ⁴	IAQ _m ¹ - HI _h ⁴	IAQ _h ² - HI _h ⁴	IAQ _m ¹ - HI _h ⁴
3 (3)	IAQ _m ¹ - HI _m ³	IAQ _m ¹ - HI _h ⁴	IAQ _m ¹ - HI _m ³	IAQ _m ¹ - HI _h ⁴
4 (4)	IAQ _m ¹ - HI _h ⁴	IAQ _h ² - HI _m ³	IAQ _h ² - HI _m ³	IAQ _m ¹ - HI _h ⁴
5 (5)	IAQ _h ² - HI _m ³	IAQ _h ² - HI _h ⁴	IAQ _h ² - HI _m ³	IAQ _h ² - HI _h ⁴
6 (6)	IAQ _h ² - HI _h ⁴	IAQ _m ¹ - HI _m ³	IAQ _h ² - HI _h ⁴	IAQ _m ¹ - HI _m ³

1 moderate IAQ condition (class B): > 800 ppm ≤ 950 ppm CO₂; 2high IAQ condition (class A): ≤ 800 ppm CO₂; 3moderate lighting quality condition (class B): 500 lx Ehor; 4 high lighting quality condition (class A): 750 lx Ehor

At the end of the lecture, after approximately 90 minutes, the lecturer left the classroom, and the researcher entered and asked the students to participate in the study. The degree of participation was high, reaching approximately 90% of all students present.

Set up and monitoring of actual indoor environmental quality conditions

In a central position in the classroom, a Delta Ohm HD32.3TCA Thermal Microclimate sensor, ACCREDIA calibrated, was placed at a height of 1.1 meters. This device recorded every minute the

actual air temperature (t_a), globe temperature (t_g), relative humidity (RH), CO₂, particulate matter (PM₁₀) and total volatile organic compounds (VOC). Figure 2 shows the layout of the classroom and technical details of the HVAC system.

At the beginning of each lecture, the desired concentration of CO₂ (< 800 ppm or > 800 ppm ≤ 950 ppm CO₂) was set in the CO₂ controlled ventilation system. Additionally, the desired HI level at the lecturer's task area was set to either 750 lx or 500 lx. The average HI level at the students' task area corresponded to that of the lecturer's task area, with a variation of approximately ± 50 lx.

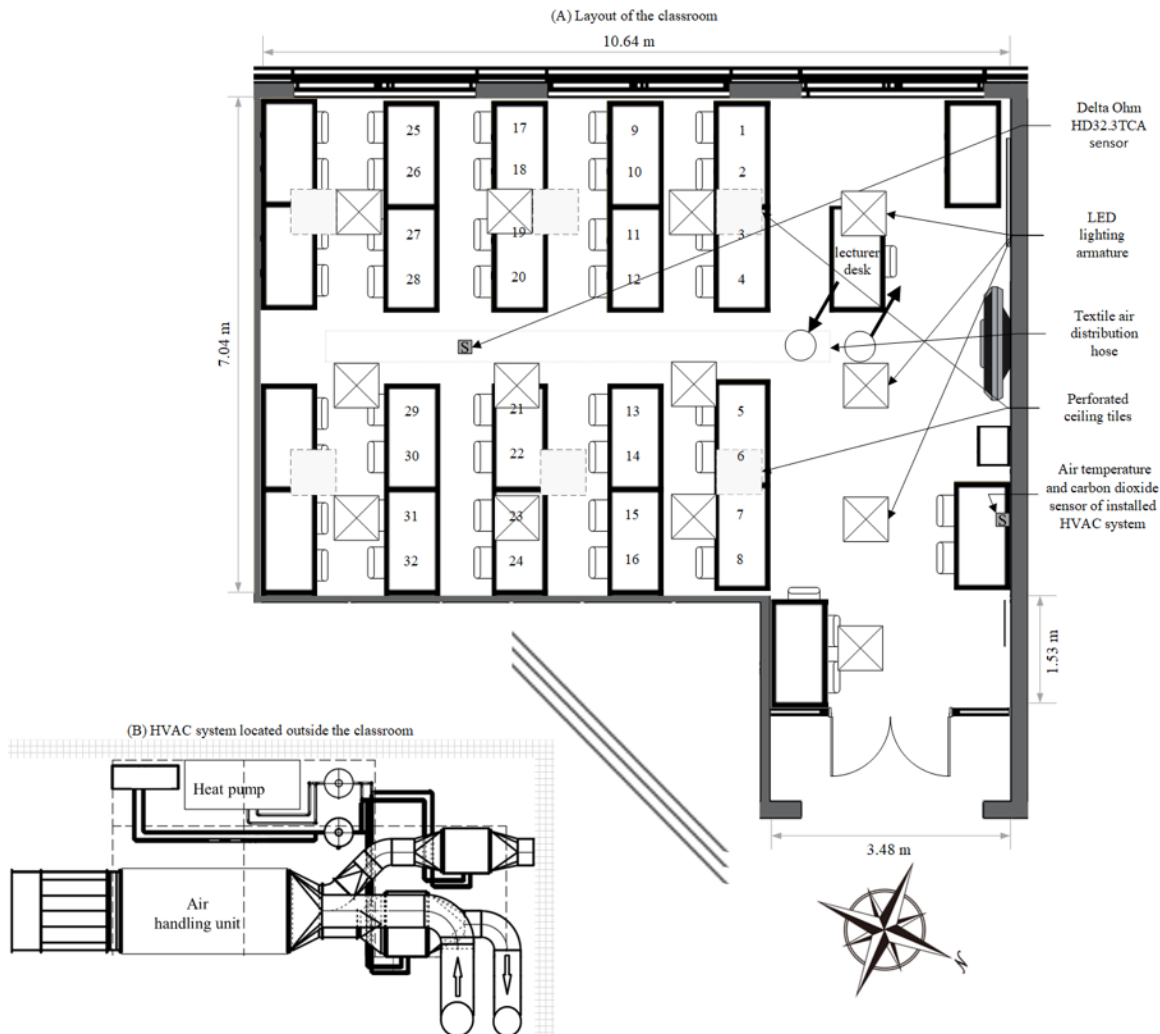


Figure 2 Layout of the classroom including the orientation (A) and technical details of the heating, ventilation, and air conditioning (HVAC) system (B)

Data collection procedure of moderators and outcome variables

A previously developed method was used to measure students' perceived comfort and performance (Brink et al., 2022). The questionnaire consisted of general items age, gender, table number, and self-reported hours of sleep before participation. The table number was used to determine the distance between the seated student and the lecturer. To determine the students' perceived lighting comfort (PLC), the combined scores of nine statements covering the topics amount of light, reflections, glare, and visibility were used. To measure students' perceptions of the IAQ (PIAQ), they had to respond to eight items covering the topics air quality, ventilation, odour intensity and character, and moisture. The students' perceived cognitive performance (PCP) was measured with questions addressing four cognitive response categories, i.e., attention and concentration, memory, perception, and problem-solving performance (Xiong et al., 2018). In addition, students had to respond to three statements

related to the students' perceived productivity and reading and writing skills to determine their perceived quality of learning (PQL).

To measure students' short-term academic performance, a content-related test was composed in collaboration with the involved lecturers (McDonald et al., 2004; Shelton et al., 2009). Before making the content-related test, students had to fill in the questionnaire which evaluated their perceptions regarding the IEQ, internal responses, and quality of learning. By using this order, the time span between the lecture and the content-related test was increased and the students were forced to focus their thoughts on other aspects than those covered during the lecture (McDonald et al., 2004). The content-related test consisted of ten multiple-choice questions relating to the topics covered during the lecture. Each week new topics were discussed and tested, no topics from previous weeks were evaluated. Therefore, it was assumed that the learning outcomes of each lecture were not affected by the learning outcomes from previous lectures. Given the potential variability in test difficulty across different weeks, short-term academic performance is measured as the deviation from the mean score of all students who completed the test during the same week. Furthermore, students had to report the time when they started the test and when they finished the test. The deviation from the mean time spent on the test was also considered as an indicator of students' short-term academic performance.

Data and statistical analysis

After data collection, an analysis of Cronbach's alpha (α) values was performed to assess the internal consistency of all perception scales. When the α value was $>.70$ the scale was considered reliable and the mean perception score was calculated (Tanabe & Nishihara, 2004).

Mixed-effects linear models (LMMs) were applied with a student specific random intercept to test for the statistical significance of the main and interaction effects. These models include the main effects of the factors. LMMs by outcome variable were applied to evaluate students' responses under the varying conditions of the factors HI and IAQ. When applicable, students' responses were statistically corrected for the moderator gender, the number of hours of sleep before participation, and distance to the lecturer (the latter being derived from their seating position) (Gentile et al., 2018; Norbäck et al., 2013). In addition, the LMMs were controlled for individual student level by random intercept because the same respondents and sometimes they did not. Therefore, the composed models account for both fixed effects which are consistent across individuals and random effects which capture individual variability. Furthermore, the models were computed with a general unstructured covariance matrix dealing with the dependent repeated measurements in the design. Main and interaction effects were considered statistically significant at a p -value $<.05$. Significant estimates of fixed effects (β) are presented as a percentage of the corresponding (perception) scale.

The two levels of the factors HI and IAQ were considered as independent factors in all LMMs. The LLMs which revealed significant effects were verified by the significance of the LMM parameters estimated by robust LMMs (Yohai et al., 1991). When these robust analyses led to a different conclusion regarding the estimated coefficient (β) beyond the first decimal, this is reported. The LMM function in the linear mixed-effects models package (lme4) in R version 3.5.0 (R Foundation for Statistical Computing, 192 Vienna, Austria) and IBM SPSS Statistics Version 28.0.0.0 (190) were used for statistical analyses.

RESULTS

Of 83 students, a total of 285 responses were collected and analyzed. Attendance at the lectures was not mandatory, resulting in a varying attendance rate averaging 15 ± 5 students per lecture. Furthermore, this resulted in an unequal distribution of responses across the four combinations of moderate-high HI and IAQ conditions. As a result of the small number of students present in the classroom and minimum ventilation flow rate of the HVAC system, the desired moderate IAQ was not achieved in some runs. Consequently, all responses were classified as moderate or high IAQ quality conditions based on the actual conditions observed. The duration of the lecture, and therefore the exposure to the tested IEQ conditions, was approximately 90 minutes. During the experiment, the

average outside temperature was 5.5°C (min 1.8– max 9.8°C). Table 2 presents an overview of the number of students who participated in the experiment and the actual classroom conditions during the four combinations of moderate-high HI and IAQ conditions.

Table 2 Overview of preset and actual indoor environmental conditions during the experimental runs

C	n	%	Setp. E_{hor}	Setp. CO ₂	Avg. CO ₂ (min-max)	Avg. t _a (min-max)	Avg. t _g (min-max)	Avg. RH (min-max)	Avg. VOC (min-max)	Avg. PM ₁₀ (min-max)
			[lx]	[ppm]	[ppm]	[°C]	[°C]	[%]	index	[µg/m ³]
1	55	73	500	>800	865	21.3	19.9	44.4	217	2.6
				<950	(651-1036)	(20.2-22.1)	(19.9-21.5)	(42.5-46.0)	(106-350)	(0.25-15.8)
2	96	69	500	<800	668	21.3	21.0	40.6	206	3.0
					(547-790)	(20.8-22.1)	(20.4-21.6)	(38.3-42.6)	(94-364)	(0.5-20.7)
3	32	66	750	>800	836	21.2	20.4	31.6	192	3.0
				<950	(558-943)	(20.6-21.7)	(20.3-21.4)	(29.6-33.2)	(111-328)	(0.5-17.9)
4	102	69	750	<800	627	21.0	20.2	37.5	159	2.6
					(511-749)	(20.5-21.7)	(20.1-21.1)	(35.6-39.7)	(64-356)	(0.6-16.7)

C: experimental condition; n: number of participants; E_{hor} : horizontal illuminance; CO₂: carbon dioxide; t_a: air temperature; t_g: globe temperature; RH: relative humidity; VOC: volatile organic compounds; PM: particulate matter

Regarding the research question, whether increasing HI levels from 500 to 750 lx and improving IAQ from CO₂ concentrations from between 800 and 950 ppm to below 800 ppm impacts students' perceived comfort and performance, first Cronbach α -values for the perception scales were computed (PIAQ, PLC, PCP, and PQL). The Cronbach α -values ranged from .85 to .91, showing that all perception scales have considerable reliability (Tanabe & Nishihara, 2004).

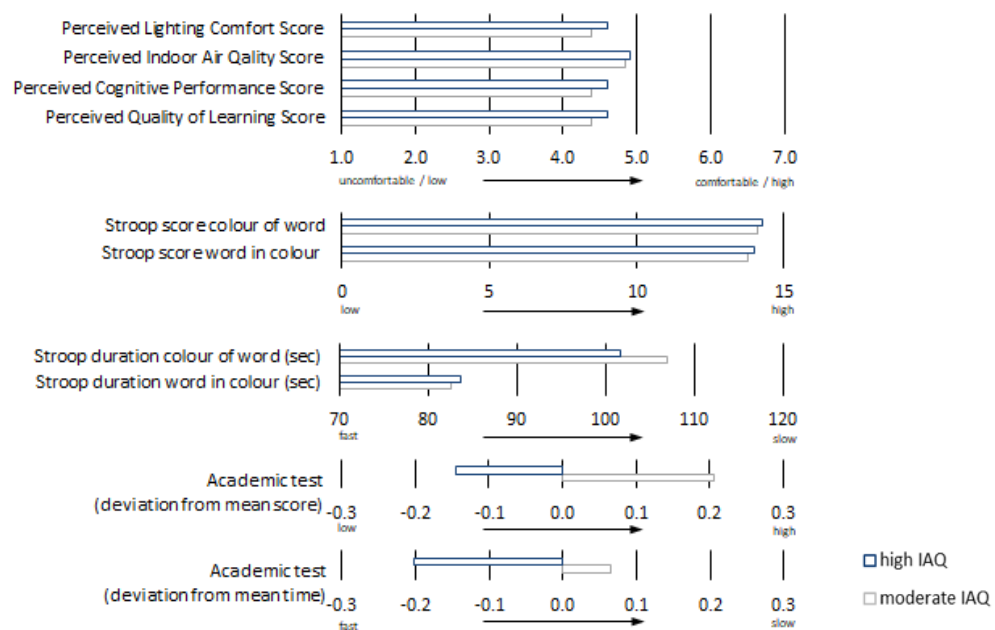


Figure 3 Mean scores on IEQ comfort, Stroop test, and short-term academic performance scales at moderate and high indoor air quality (IAQ) conditions. Source: Authors' own work

Next, LMMs were computed for all outcome variables using the factors HI and IAQ. Additionally, the variables gender, the estimated number of hours of sleep before participation, and distance to the lecturer were included as covariates in the LMMs. The factor IAQ did not reveal any significant effect. The factor HI had a significant effect on students' PLC. Students evaluated their PLC and PIAQ higher at high HI conditions, compared to their scores at moderate HI conditions (PLC $\beta=0.17$ (3%); $t(277)=1.92$; $p=.010$ and PIAQ $\beta=0.23$ (4%); $t(277)=2.11$; $p=.036$). Furthermore, the factor HI positively influenced students' scores on the Stroop test ($\beta=.76$ sec; $t(271)=2.20$; $p=.029$). These LMMs did not show a significant effect of the moderators gender and number of hours of sleep before participation. Figure 3 shows all mean scores on comfort, cognitive, and short-term academic performance scales at moderate and high IAQ levels. Figure 4 shows all mean scores on comfort, cognitive, and short-term academic performance scales at moderate and high HI levels

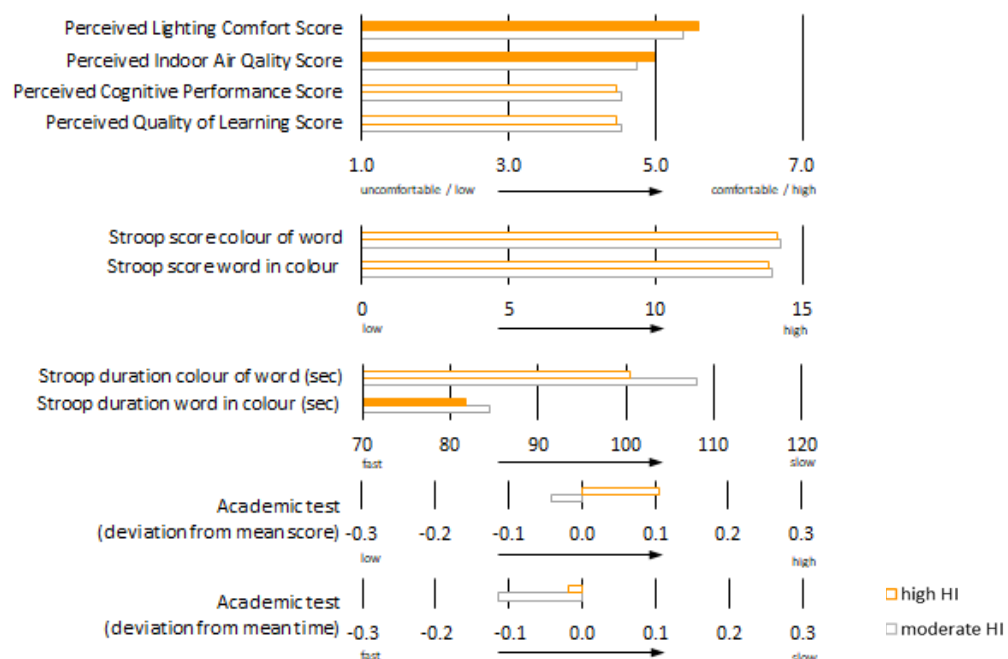


Figure 4 Mean scores on IEQ comfort, Stroop test, and short-term academic performance scales at moderate and high illuminance (HI) levels. The bar in the graph is highlighted in yellow to indicate a statistically significant effect of the factor HI ($p<0.05$). Source: Authors' own work

To determine interaction effects between the factors IAQ and HI, LMMs were computed with the comfort, cognitive, and short-term academic performance scales as outcome variables and the factors HI and IAQ as predictor variables. Additionally, the variables gender, the estimated number of hours of sleep before participation, and distance to the lecturer were included as covariates in the LMMs. Significant two-way interactions occurred in LMM PLC: Moderate IAQ*Moderate HI ($\beta=-0.40$ (7%); $t(278)= -3.863$; $p=.000$); LMM PLC: High IAQ*Moderate HI ($\beta=-0.25$ (4%); $t(278)= -3.064$; $p=.002$). The LMM PLC at Moderate IAQ*High HI was not significant ($\beta=-0.24$ (4%); $t(278)= -1.909$; $p=.057$). Figure 5 shows the mean fixed predicted values at moderate and high HI by moderate and high IAQ conditions.

HI 750 lux	5.709 ¹	5.472
HI 500 lux	5.457 ^{**}	5.309 ^{***}
	< 800 ppm CO ₂	> 800 ppm ≤ 950 ppm CO ₂

¹=reference condition score; ** = p < 0.01; *** = p < 0.001

Figure 5 Mean fixed predicted values of perceived lighting comfort at moderate and high horizontal illuminance (HI) and moderate and high CO₂ levels

DISCUSSION

This study examined the single and combined effects of lighting conditions measured by HI and IAQ in higher educational settings. Lighting and IAQ conditions are critical factors influencing both the quality of teaching and learning, as well as students' comfort and performance (Brink et al., 2021). Individually, optimal lighting conditions have been shown to enhance visual comfort, reduce eye strain, and improve students' level of concentration (Brink et al., 2021). Similarly, good IAQ, characterized by adequate ventilation and low levels of pollutants, is essential for maintaining students' health, reducing absenteeism, and enhancing cognitive performance (Brink et al., 2021).

Du et al. (2020) reported that studies that examine IAQ conditions with CO₂ concentrations between 600 and 1100 ppm do not provide unequivocal evidence. The IAQ conditions, which were examined in this study, are within this range and indeed did not reveal any significant effect on students' perceived IAQ and performance; confirming that the subjective evaluation of IAQ is a complicated evaluation and can be affected by other IEQ factors and psychological factors (Jiang & Yang, 2011). Nevertheless, students' scores on all comfort scales were higher when students were exposed to a high IAQ compared to moderate IAQ. Although previous research revealed an adaptation time of approximately 20 minutes (Mishra et al., 2017), the duration of exposure to the experimental condition was relatively short, approximately 90 minutes. Therefore, it is likely that the impact of IAQ increases with longer exposure and possibly reaches statistical significance.

Furthermore, the two examined IAQ conditions significantly affected students' PLC; a higher IAQ positively influenced students' PLC although this effect was relatively small. This relation between illuminance levels and IAQ was also reported by Jiang and Yang (2011), and in an academic context by Pittana (2022). Furthermore, the factor HI influenced students' PLC and cognitive performance; students evaluated their PLC higher and completed the Stroop test faster at higher HI levels confirming the findings of Granito and Santana (2016). However, in this study, lighting was only measured via HI which aligned to performance of visual tasks (Boyce, 2014). Other light factors influencing the personal lighting conditions, e.g., ambient illuminance, correlated color temperature, contrast, or daylight factor (Brink et al., 2022; Van Duijnhoven et al., 2021), were not considered.

This study found an interaction effect between the factors IAQ and HI on PLC. Available evidence of interaction effects of the IEQ factors lighting and IAQ conditions on students in higher education is limited (Brink et al., 2021; Torresin et al. 2018). For example, Torresin et al. (2018) reported an interaction between illumination and air freshness and odor perception; however, they stated that this interaction was not clear. With the new presented evidence regarding the relation between IAQ and HI, this study seeks to enhance our understanding of the interaction effects between indoor environmental quality (IEQ) factors, and particularly on how the factors IAQ (expressed in CO₂ concentration) and HI (expressed in lux at desktop) affect students in higher education.

CONCLUSION

This study examined the impact of enhanced lighting (HI at desktop) and IAQ (measured via CO₂ as a proxy) on higher education students during a regular academic course. With a full-factorial experimental design, the effect of quality class A (high quality) versus B (moderate quality) requirements of Dutch guidelines for school buildings for HI levels and IAQ was examined. The results

indicated that exposure to high quality IAQ levels for approximately 90 minutes did not significantly enhance students' perceived IAQ and performance, compared to moderate levels. In contrast, exposure to high HI levels did contribute significantly to students' lighting comfort and students' cognitive performance, compared to moderate HI levels. However, the effect size was relatively small (3-4%). Furthermore, students' PLC increased under high quality HI and IAQ conditions (+7%) compared with their PLC scores under moderate quality conditions. Although the observed effect sizes are small, they can have a significant impact on students if they persist over an extended period and influence a large group of students in higher education classrooms.

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Managing Facilities on University Campus – What's Strategy Got to Do with It?

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ABSTRACT

Background and Aim. University campuses serve as dynamic environments for work, study, teaching, and research within multidisciplinary communities. This paper aims to identify the challenges and prospects for facilities management (FM) in university settings.

Methods and Data. This viewpoint paper is grounded in two platforms. First, it draws on the authors' experiences in reviewing recent research on FM in academic environments. Second, it incorporates insights from one author's practical involvement in Norway's largest campus development program at NTNU. This combination of theoretical and practical perspectives highlights emerging trends and suggests directions for future research.

Results. The academic landscape is undergoing significant changes, characterized by evolving pedagogical approaches, enhanced equality in student-teacher relationships, and the emergence of new workspaces for staff. These developments necessitate a shift in FM from merely managing physical buildings to facilitating adaptive practices. We present three essential viewpoints for modern FM: 1) Negotiating the Unknown: adapting to new working methods embraced by students and staff, 2) Balancing Social Connectivity and Privacy: fostering social interactions while respecting privacy, and 3) Strategic Tool for Change: aligning with organizational strategies to support institutional transformation.

Originality. This paper uniquely emphasizes the interplay between FM and the academic environment, contrasting with traditional research that often treats urban or organizational contexts as separate entities.

Practical Implications. The identified themes assist campus facilities managers in recognizing cultural aspects tied to academic heritage and its ongoing transformation within universities. This understanding is vital for effectively navigating the complexities of contemporary campus environments.

Type of Paper. Viewpoint

KEYWORDS. facilities management, hybrid, privacy, social connectivity, university campus

INTRODUCTION

Facilities management (FM) encompasses multiple disciplines to ensure functionality, comfort, safety, and efficiency of the built environment by integrating people, place, process, and technology as stated in international facilities management association (2022). This is supported by the International Organization for Standardization (ISO), which complement this definition by identifying FM as the organizational function which integrates people, place, and process within the built environment to improve the quality of life of people and the productivity of the core business. The transcription of these definitions in different fields, practices and disciplines is interesting especially after the systemic change in society after COVID-19. Nenonen et al (2023) queries how diverse organizations determine the process of crafting an organizational culture, addressing new user needs as well as transforming multilocal work practices.

In the process of developing a special issue on Higher education: “Academic spaces for working and learning post COVID-19” published in *Facilities* (2025), editors who are two of the authors reflect on the entanglement of facilities management and academic work in higher education. In some ways, the social entanglement of students and staff is somewhat assumed rather than clearly visible within the spatial configuration. The following outlines the challenges two of the authors saw arising from the different articles that were submitted to the special issue and open a dialogue through this article with our co-author whose experience is primarily from the practitioner view on campus development.

METHODS AND DATA

This viewpoint paper leans on a dual platform and reflective dialogue between research and practice. The research approach is based on the authors’ experiences reviewing the latest facilities management research on facilities management in academic working and learning environments. Reflecting on the final versions of articles that were accepted as well as on the articles that were not accepted – we see that there is a need for more visibility of facility management in higher education. Within this work we consider “what has strategy got to do with it” when it comes facilities management in the manages of space in higher educations.

In this paper, we identify three important themes, two that are at the core of the discussions in the revised papers (FM as negotiating the dilemma of social connectivity versus privacy, and FM negotiating the unknow and new ways of working). The third theme is somewhat lacking in the reviewed papers, but sought for both in facility management literature at large, and very present in the practical experience from Norway’s largest Campus development program (FM as a strategi tool, supporting change in line with organizational strategy).

The special issue aimed to examine higher education spaces, focusing on both working and learning environments, to highlight the visibility and importance of facility management within these contexts. The leading question was: How has facilities management responded to the new challenges and opportunities presented by COVID-19? The journal focused on exploring how universities have adapted their spaces and services to meet the demands of the post-pandemic era. The notion of “COVID-19 legacy” frames this discussion, emphasizing lasting transformations rather than temporary disruptions. This special issue is published to showcase the latest research on the evolving role of Facilities Management (FM) in university campuses and higher education. (Lindkvist et al. 2025). The eight articles of the publications are used as empirical material in this paper.

NTNU Campussamling (Norwegian University of science and technology) is a project initiated to collocate all of NTNU Trondheim, with its approximately 35 000 students and 8960 staff. NTNU has a special cross disciplinary mandate from the Norwegian government. Until now, the faculties of humanities and social sciences are located in a campus outside the city, while technical, medical and economical disciplines have been co-located closer to the city center. With a strategic goal of facilitating cross-disciplinarity, particularly among students, the planning of a grandiose project started. Through the project, all the different disciplines at NTNU are gathered at Campus Gløshaugen. The Humanities and Social Sciences are moved to the existing city campus alongside Civil Engineering, Economics, and Medicine studies, making it practically possible for students to choose courses across traditional disciplines. The Norwegian government is investing 600 million euros in the building project, with little to no evidence that this co-location will enable more cross-disciplinarity. However, the rationale is that it will remove practical constraints for student cross-disciplinarity, such as travel time between campuses.

During the last 10 years a wide range of internal and external stakeholders have been involved in order to plan and finance this complex construction project. The construction phase has just started, and by 2030, 91000 new square meters intertwined with and on and already existing city campus of 600 000 sqm will be raised. The construction takes place on a living campus, the work and learning space for more than 35 000 students and 8000 employees. The management of existing facilities, and the preparation for new facilities is done parallel to the building projects.

The viewpoints presented here were based on discussions from the perspective of research agenda for future research especially in facilities management and university campus development. The intention is to identify what research we do not have, and that is needed in practice.

THREE VIEWPOINTS

Viewpoint 1 Facilities management as negotiating the unknown, in a world where students and staff alike are engaging in new ways of working

Research in facilities management within the educational landscape emphasizes the need for a proactive, flexible approach that incorporates technology and user feedback (Sun et al., 2025; Martinez et al., 2025). While, facilities management has a mission to create a work environment that promotes occupant well-being and productivity (IFMA, 2022) within university landscape this must include the welfare of users in learning spaces. Einola et al. (2024) states that designing post-pandemic offices or new normal offices is a dynamic research area, and further research is needed to understand how to optimize space reductions while supporting collaboration, innovation and organizational learning. There is a lack of research into the post-pandemic era in facilities in universities and facilities management in the campus context to identify the unknowns that require broad engagement of users and understanding of the dynamic spatial configurations.

This is mirrored in the special issue of Facilities: Higher education: Academic spaces for working and learning post COVID-19. Within hybrid learning environments, Wheele et al. (2025) discuss how the legacy of covid prevails in campuses as the physicality of spaces is being pushed to be digital. This shift is driven by students' desire for flexible learning options—both synchronous and asynchronous—which hybrid digital/physical environments can support. To meet these evolving needs, both learning and working spaces must be designed with input from the people who use them. At the same time, it's important to consider how technology continues to influence these spaces, as the pandemic demonstrated the value of adaptable environments that can respond to changing demands. However, translating cultural norms from physical spaces into digital ones is complex. The way spaces are configured—whether physical or digital—affects how users experience and interpret them, often in very different ways (Wheele et al., 2025).

In academic work environments, individual offices are deemed to be not the most efficient use of space but are rated quite highly for concentration work (Indergård, 2025). In this sense, academic spaces for working need to develop spaces for a multitude of functionalities. The old view of an academic office being one where the professor is buried in books working alone is no longer the reality. Yes, academic knowledge work needs spaces for concentration but also spaces for interaction and for expressing their identity (Indergård, 2025). Also, Bennis and Orel (2025) identify the complexity of the campus in their four models of campus co-working recognizing that not all work is attached physically to the campus. Their four models – home campus coworking which is more traditional to the campus; intercampus working hosting student, teachers and researcher of other universities; off-campus coworking for scholars who work off campus in spaces promoting knowledge-based work in community locations through reciprocal agreements; campus as a service serves remote scholars from campus like environments who are from multiple institutions. Such approaches to campuses offer flexibility that can adapt to changing ways of working which is influenced by the environment and the activity. Similarly, Miglore's (2025) multi-locational academic work concept illustrates the complexity of balancing multiple workers' needs with location. This Italian study highlights how knowledge workers are more satisfied to work on campus than to work alone from their home but at the same time this satisfaction varies based on the correlation of spatial configuration to both locations (Miglore, 2025). While this might be cultural, it is indicative that more focus needs to be considered for spatial configuration in multiple locations leading to multifunctional campus.

Through the Campussamling project, the layout of the lecture halls are being changed. All lecture rooms being built through the project (more than 10 000 sqm of them), is built as flat, flexible rooms, offering for the lecturer as well as the students, spaces designed to engage staff and students in

student active learning, a large portion of these developed with large built-in technology for hybrid work. An important questions prevails – how will the staff (and the organization at large) be equipped to fill the classrooms with the pedagogical possibilities these new learnings spaces can cater for, and how will these new learning spaces affect student learning if the academic staff is not capable or willing to embrace and cater for the new pedagogical possibilities the learnings spaces are designed for. As the project progresses, it becomes increasingly clear that this decision regarding the built environment is intertwined with numerous processes across the university. These include the development of pedagogical methods and tools for academic staff, the need for a "time planning tool" that considers teachers' spatial needs—not only in terms of the number of students in class but also in terms of pedagogical style. Additionally, it touches on the larger issue of university financing, as student-active learning activities tend to involve smaller classes and are thus more costly than traditional lecturing.

In short, changing the learning spaces necessitates changes in a wide range of organizational issues to ensure the university is "future-ready" for the new built environment. How should the organization facilitate these changes, and how may facilities management help?

Concomitantly, the layout of the employee offices will be changed. The Norwegian government has imposed on the Norwegian public sector a standard square meter use for offices. This is a decision based on economics and sustainability. For practical purposes this governmental standard will in most (new) buildings provide 25 - 35 % cell offices. This is a change in office layout that demands new ways of working by the employees, they are unsure on how they will be able to solve all the tasks that was previously performed in and by the cell office, and the planned change has sparked a huge controversy. Admittedly this is a live experiment, in which organizational changes in practice and new buildings are developed simultaneously. It is a live experiment in which the existing research on workplace development is antagonistic to say the least.

NTNU has clearly stated that the campus should be the preferred workspace for students and staff alike. This is the driving force behind the building project. There has been a great emphasis on creating social and workspaces for students, who have been the main beneficiaries in terms of space—reducing staff office workspace in favor of teaching and learning spaces. At NTNU, interviews with employees have shown that "the academic office" has a range of different uses. It is described as a library, an extended memory, a supervisor and meeting room, a room for digital work; for meetings and recording of lectures, a room for concentration and solitary work, a room for privacy, a symbol of autonomy, and an invitation (through the open door). Also, the amount of hybrid work increases. The ease of meeting with peers from different universities (or campuses), collaborative partners, even students, are facilitated by always developing technology, and the forced period of hybrid work during Covid, has provided capabilities in hybrid work not previously seen/known. Employees are particularly worried that their hybrid work, in particular collaboration with academic peers off campus, will suffer from the lack of traditional office spaces. To some extent, this is a large-scale experiment in which NTNU tries to facilitate face-to-face meetings and experiences. Among students and staff.

Lessons learned

Both research findings and NTNU's perspective highlight a growing demand for hybridity and multifunctionality in teaching and learning environments. The push for these changes primarily originated during the pandemic, which served as a catalyst for rethinking how educational spaces are designed and utilized. This shift has left a lasting legacy, prompting institutions to adapt their facilities to better support diverse learning needs.

Several factors influence the creation of these changes. First, there is the core functionality of the spaces, which must align with the needs and preferences of users—students and faculty. Second, the strategic goals set by the institution play a crucial role in determining what changes are feasible. Facilities managers are essential in this process, acting as facilitators of change by implementing various support functions.

However, challenges arise from the often-unclear picture of user demands. Students and faculty may have differing expectations and requirements, making it difficult to pinpoint exactly what is needed. At the same time, institutional strategies may impose limitations that complicate the decision-making process. As a result, facilities managers must navigate these complexities to create flexible and effective learning environments that meet the evolving demands of education.

Viewpoint 2 Facilities managements as negotiating the dilemma of social connectivity versus privacy

The university campus serves as a vital space for community building and a sense of belonging, with the concept of shared campus playing a significant role in fostering this environment. The focus in research about sharing facilities is many times in BIM (Building information model) enabled facilities management, where data and information is in the main role and used as a tool to manage the maintenance and use of facilities, e.g. Le et al. (2024). Lundgren et al. (2024) state that sharing and digitalization are efficient circular strategies which allow for flexibility, multifunctionality, and maximizing the use of existing assets. In facilities management literature, there is a growing emphasis on how spaces can be shared and the digital tools that facilitate this process. However, there is less focus on identifying which specific spaces can be shared and how different users can benefit from these arrangements.

We see discussions about social connectivity and privacy in relation to sharing. Collaboration is a key part of the learning process and sharing spaces is key to collaboration and should be considered prominently within campus solutions both within the work and learning spaces. This is supported in Toprakli and Satirs (2025) work on shared learning space and social connectivity in learning space, but they also find that that the provision of shared spaces needs to be supported through good technology infrastructure. The desire that academic departments have for colleagues to work closely together is often hindered by the reliance of digital meeting spaces replacing physical meeting places tend to hinder propinquity as there is less opportunities for social interaction, collaboration and unplanned meetings (Indegård, 2025). The time of the meeting in a digital space is fixed and bounded, while in a physical space affords more fluid social connectivity. Common shared spaces such as corridors or elevators afford propinquity as they create moments to stop and interact with a colleague (Indegård, 2025). Ironically, intentional shared spaces such as shared office spaces lead to less opportunities for propinquities as social interaction is limited by the reduced affordance of privacy to enable a social interaction with a colleague without disrupting others in the office. When considering multifunctional, shared campus spaces, like libraries, it can be challenging to satisfy all users. Even though design elements like lighting and openness are appreciated, they don't significantly influence overall satisfaction (Hou, 2025). Users are diverse in terms of how they want to connect, disconnect and share spaces.

NTNU has a goal of more sharing and higher use rates of meeting rooms and student study rooms as well as teaching facilities and lecture halls that are already shared today. In the project a strategy for common areas is developed that aims at making social zones welcoming but distinct, as to foster a sense of belonging and sharing together. As the buildings and the rooms are rising, we see that this creates a wide range of facility management issues that need to be resolved. It concerns ownership, rent, cleaning and responsibility. All connected, and all needed for sharing to push beyond a need to save capital, towards a lust to share space, meet, and potentially study or work together.

As part of the NTNU Campussamling project, several partners will also share facilities with the university. These are innovation partners in the Innovation center, and industry partners in the new Materials technology center. Moving from the will to share spaces, to the practical realities of it, the facilities management division at NTNU have done much work in order to develop hiring contracts with the partners, that invites not just to rent space, but also to share and jointly use shared facilities, establishing spaces where the partners may be private and spaces where they are invited into interaction with the university,

Sharing however, is not always straight forward. The city of Trondheim, and NTNU have a shared vision of the city and NTNU sharing facilities and sharing services. This implies inviting service partners onto campus and offering services to a broader audience than students. However, the student association currently has a practical monopoly on providing food and catering services on campus. They have the right to offer these services and to receive significantly reduced rent for the space they occupy, based on the premise that the association primarily serves students. These existing regulations work against the goal of the university and the city sharing services and spaces. With these regulations in practice, the university and the city can hardly share services and spaces.

Lessons learned

Reflections of learning focus on the fact, that sharing goes beyond the technology and digitalization that enable collaboration across traditional organizational boundaries. Different users and relationships in the university community raise unique questions about how to effectively share resources and spaces.

Facilities management must refine its strategies to support users in navigating the complexities of social connectivity and privacy. This includes addressing issues such as rental structures for shared spaces, exploring services and facilities that can be collectively utilized, and ensuring that shared areas are both welcoming to the public and foster a sense of community and belonging for those who need it.

Viewpoint 3 Facilities management as a strategic tool, supporting change in line with organizational strategy.

Facilities management is driven by people, place, processes and technology (Atkin and Brook, 2021; ISO 41001). It is guided by strategic, tactical and operational levels of management but is most active at the tactical and operational levels while reactive to strategic demands (Haugen et al., 2020). In the latest literature e.g. comprehensive campus facility management performance assessment model has been explored by Gunduz and Maki, (2024) with conclusion that such methods can support organizations, facility managers, and policy makers when making well-informed decisions, the context is not strategic. Swedish public facilities management organizations have been investigated by Bertz et al. (2024) with the focus on a new type of strategic planning measure known as strategic public facilities management (SPFM). One could consider campus management in the context of strategic public facilities management, while literature in campus context is rare. All in all, Nenonen et al (2023) state that the role of a facility manager is becoming more prominent in the post covid era, and the facility manager should perceive that crisis as an opportunity to step up and support the organization in its strategic policy.

The articles in this special issue address critical topics related to campus development in the post-COVID era. However, there is a notable gap in the approach to strategic facilities management, particularly regarding its role in the context of evolving learning environments. While much of the existing research emphasizes academic work, pedagogy and teaching as well as campus services' needs, there is insufficient alignment between the university goals including e.g. pedagogical goals and how facilities effectively support them.

The physical structure of the classroom is a strategic power statement based on the long history of the assumption of how learning takes place and how teaching should be organized. Teaching, learning and research are key strategic activities in any university campus, but these activities are not only set in the arena of the physical campus, but they also take place in digital spaces and places (Wheele et al., 2025). Options for what is space for knowledge workers and students increases complexity of defining spaces within spaces that are diverse and challenges strategic management to think laterally on what campus spaces are for all users both physical and virtual. With COVID, the term "hybrid" blurred the power statement of the classroom on campus. It was no longer just in relation to the physical environment but also the digital and liminal spaces. It is this aspect of space that facilities management has the potential to rejuvenate but also to understand to manage the

tactical measures that these spaces require, but it is this understanding that must be led by strategic management. Change is ongoing, yet the digital campus is reliant on existing digital platforms. While many students view digital platforms to afford flexibility (Wheel et al., 2025), access to digital spaces cannot always be assumed. Toprakli and Satir (2025) illustrate the lack of consideration of diversity amongst students at the strategic level as well as access to good technology solutions when it comes to the hybrid means that all students are not being considered with the phygital world of hybrid campuses. In addition, Obuobisa-Darko (2025) study illustrates how one student was potentially prevented from accessing a virtual classroom due to the need to purchase data and through the support and camaraderie among classmates was able to purchase the data. Traditional strategic assumptions about learning and working in physical campus spaces are challenged by the rise of hybrid and digital spaces. Facilities management is positioned as having the potential to rejuvenate and understand the changing nature of campus spaces—both physical and digital, but this must be guided by strategic leadership to ensure inclusivity, flexibility and sustainability.

NTNU has a strategic goal of facilitating student active learning. The Campussamling project plans more than 22 000 sqm learnings spaces, divided between approx. 10 000 sqm teaching areas 12 000 sqm student workplaces in a variety of functions and shapes. Because of the strategic discussion all teaching spaces built through the Campussamling project is planned as flat, flexible working spaces, offering a range of tools (technical and analogue) to enhance the collaborative processes between student, and between students and teachers. The Campussamling project will renew approximately 10 % of its teaching spaces. What has not been part of the overall strategic decision, but has slowly emerged through the planning process, is the demand that these new spaces will set on facilities management: The system for planning which rooms goes to which classes needs to be adjusted for the pedagogical profile the teacher bases his classes on, the technical staff that is needed to keep the technology up and running, and the teachers up to date on how to use it, are but just a few examples of consequences of strategy, for facilities management.

At NTNU, strategic discussions on future spatial needs were primarily driven by academic staff. This was very important to ensure sufficient futureproofing of the strategic plans, as well as sufficient belief in the needed changes. However, when strategic ideals were transformed into physical buildings under less-than-ideal economic conditions, this led to the suggestion of some suboptimal solutions from the contractor. For example, large, flat learning spaces where the ratio between floor height and distance to the screen creates issues for universal design. In these situations, the tactical know-how of facilities managers in combination with the strategic goals has been crucial, enabling both the prioritization between different suggested solutions, and the evaluation of cost – benefit for NTNU (as opposed to cost – benefit for the contractor).

Looking away from teaching and learning spaces to academic offices, we see yet another example of interdependency between strategy and tactical know-how. In the Campussamling project, the brief states that there should be a built-in flexibility in workspaces, enabling rapid changes in the office layout. The strategic emphasis on building flexibility in workspace areas is a consequence of NTNU's facilities management expertise regarding which types of spaces are most often in need of change. Also, new types of working spaces, with open solutions, set demands for new security measurements for information as well as employees. And new policies for locking and unlocking office doors etc.

Throughout the planning and the execution of the project, we see that strategic decisions and tactical considerations often are out of synch. Strategy and goals are set in a forward-looking manner, sometimes with too little orientation toward the practical consequences, and like ways, sometimes practical consequences stand in the way for strategic goals, just because they were not sufficiently integrated at the proper stage of planning. Having a huge project like the NTNU Campussamling project becomes an amplifying glass to see how the strategic, tactical and operational consideration of campus development are intertwined. However, this amplifying glass does not only expose collaborative possibilities in the project, but also stretches out to the additional 700 000 m² that NTNU owns and facilitates

Lessons learned

To navigate these challenges effectively, facilities managers must adopt flexible, collaborative, and innovative approaches that prioritize the needs of the entire university community while aligning with institutional goals. Embracing the principles of circular and sharing economies can enhance sustainability and resource efficiency but requires a strategic vision and commitment to foster a culture of collaboration and sustainability across the campus.

There is still a lack of visibility of student experiences that cannot be accounted for at the strategic level. When the campus goes beyond the physical boundaries and into the digital realm, it is not possible to account for all variables at the strategic level. In this way, while the legacy of COVID created opportunities on how to rethink the campus at the strategic level, the limitations of the digital campus were also highlighted with trying to make the digital experience the same as the physical experience.

CONCLUSION

According to theory, campus management can be considered as the alignment process between goals and resources, integrating four different perspectives (Den Heijer, 2012): the organizational perspective, the functional perspective, the financial perspective, and the spatial perspective. The latter includes both the virtual campus and the physical campus. The three thematic viewpoints (Figure 1) can be reflected from these perspectives and use it as a framework to identify the research agenda – what we do not know yet?

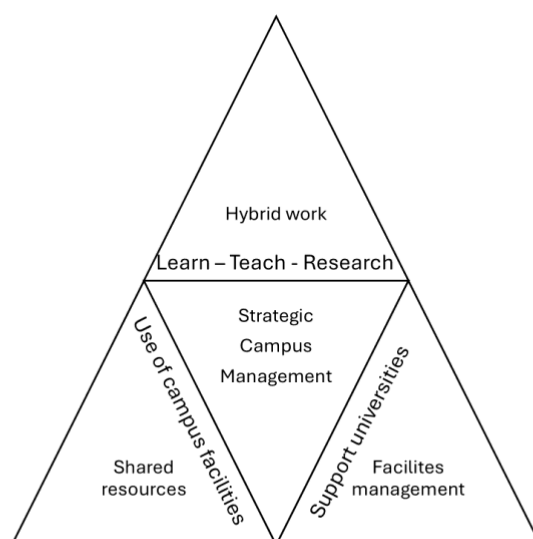


Figure 1 Framework for research agenda. Source: Authors' own work

To understand more the hybrid work and new ways of working the research topics are:

- Integration of digital and physical learning environments by investigating best practices for integrating digital tools with physical spaces to enhance hybrid learning experiences.
- The research about the impact of digital platforms on collaboration and engagement in working and learning environments is needed.

To learn more about the use of shared resources, and the negotiating of the dilemma of social connectivity versus privacy on campus we propose the following topics:

- User experience research can examine the hybrid user experience from the perspectives of various stakeholders (students, faculty, staff, and administration).
- To assess how different user groups interact with shared spaces, and how they negotiate the borders of “ours” and “theirs”, understanding the implications for design and management of the spaces would increase the usability of the environments.

Finally, to support the strategic facilities management on campus, we identified two approaches:

- Exploring effective management strategies for hybrid facilities, focusing on their functional and spatial contexts is an interesting research topic. Furthermore, assessing the financial implications of managing hybrid spaces, including cost-benefit analyses of investments in technology and infrastructure is needed.
- Strategic resource management and collaboration as a research topic could focus on exploring how universities can recognize and leverage campus spaces as strategic resources. Most likely we need further investigations about the importance of visibility and the role of facilities management in the university’s strategic agenda.

By addressing the three viewpoints by these six key points, this research agenda aims to provide a comprehensive understanding of the evolving landscape of hybrid learning and working environments, their use and the essential role of facilities management in enhancing the campus experience.

As a viewpoint article, this contribution carries inherent limitations, as it draws primarily on the recent experiences of its authors. While all contributors are actively engaged in campus development and facilities management and committed to providing quality environments for diverse academic spaces, the approach here leans more toward reflective commentary than rigorous analytical study.

The reflections are informed by a recently published special issue on post-COVID academic spaces, comprising eight highly relevant research articles. However, a more comprehensive literature review would have broadened the scope and deepened the insights presented. Similarly, while the NTNU campus development serves as an exemplar case, a more robust research methodology would yield stronger, evidence-based conclusions. Nonetheless, as a viewpoint, the primary aim is to provoke new lines of inquiry rather than to present definitive findings. It seeks to inspire further research and dialogue in this evolving field.

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New Ways to Classify Research Environments in Universities

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ABSTRACT

Background and Aim. University research environments encompass research and development (R&D) laboratories, as well as collaborative initiatives and joint ventures that extend beyond traditional lab settings. The research landscape on campus can be quite dispersed. This paper examines different methods for grouping and categorizing academic research environments.

Methods and Data. To gather data for preliminary understanding of the diversity of research environments, a series of focus group workshops were conducted with researchers from different universities. The research design employs an empirically grounded typology method, which aims to organize complex constructs and propose a preliminary typology.

Results. The typology of labs provides a framework to illustrate the spectrum and mutual positioning of research environments. Four typologies were identified: Research labs are the special research environments, teaching labs are the multi-use basic facilities, open labs represent the movable on-field research facilities, and the living labs are real-world environments for co-creation.

Originality. The paper aims to shed light to the elements which can be further developed to support inter and transdisciplinary research.

Practical Implications. The widening of research environments from lab-based solutions to broader contexts enhances the understanding of the research environment's scope for various collaborative activities that occur within or between disciplines and among different stakeholders. The presented typology offers an opportunity to use the mapping to comprehend different parameters and profiles of labs both for users and managers of the research facilities.

Type of Paper. Full Research

KEYWORDS. facilities management, research environments, sharing, services, university

INTRODUCTION

University research environments are often discussed in the context of laboratories. Laboratory is an academic unit, which is either in closed or open and it exists in permanent or mobile form. They play a critical role in regular class teaching and academic research, undertaking the mission of training talents and exploring the science unknowns (Wu et al., 2007).

University research environments can be also a research-conducive environments with less laboratory-like structures. Such environments can be e.g. the test beds. They in turn are related to concepts like living labs or real-world laboratories. They have emerged as a prominent approach to structure and stimulate innovation by testing new sociotechnical arrangements in situ and at a meso-scale (Engels et al., 2019). The concepts of research environments vary; however, an integrative approach is needed. Not only to develop concepts further for design of research environments but also to understand more thoroughly the services they need to ensure their responsible use. The core services and support services produced by service units on university campus need a constant dialogue (Turpen et al. 2016).

The laboratories are not only about spaces and places but also about services connected to them. The common interest and challenge for development of research environment concerns digitalization: how technology can be integrated into laboratory facilities management, including the use of smart systems for monitoring and managing resources (Rim et al., 2024, Santos et al., 2025). Additionally, issues such as safety and compliance, space utilization, strategies for scheduling and sharing resources among different research teams, and user satisfaction are all important considerations for facilities management (Wei, 2020). Modern science is strongly supported by a production structure in which teamwork, collaboration, and interdisciplinarity are among the main characteristics. Thus, studies on the collective determinants of scientific production and patenting are essential to understanding the organisation of scientific activities and aspects related to the efficiency and scope of laboratory activities (Aparecido and Kannebley, 2021).

The effective and sustainable use of laboratories is coming more strongly to agenda of research campus development. (Yläoutinen et al., 2015). There is a growing interest in how facilities management can promote sustainable practices in laboratories, such as energy efficiency, waste reduction, and the use of green materials (Freese et al., 2024). Facilities management in university labs also involves financial aspects, including budgeting for maintenance, upgrades, and operational costs (Dahuri et al. 2025).

This paper explores the alternative ways to cluster and categorize academic research environments and the interlinked services. The explorative study aims to find response to the research question: what are the ways to categorize the research environments for research, development and innovation in the research university. By clustering research environments, universities can better allocate resources, including funding, equipment, and personnel, ensuring that they are directed to areas of high impact or need. Additionally, one can assume that grouping similar research environments encourages collaboration among researchers with shared interests, leading to interdisciplinary projects and increased innovation. It is also important to identify interdependencies between different research environments and their associated services (e.g., administrative support, technical services, and training), leading to more integrated and efficient service delivery. After introduction the chapter two discusses about the different ways to cluster laboratories. The method and research design are presented in chapter three followed by results, conclusions and discussion. The research provides a preliminary framework for laboratories and service clustering.

PERSPECTIVES TO LABORATORIES FOR RESEARCH

Laboratories are complex environments. Colleges and universities need to ensure the orderly operation of these laboratories, through effective management and data analysis, reduce the potential safety hazards, and avoid unnecessary security issues (Wei, 2020). Lot of research activities in laboratories are guided by different laws, regulations and standards. In addition to traditional lab safety procedures there are also several technical requirements for the facilities and research equipment.

The laboratories can be classified to research and teaching labs. The faculty and students are exposed to equipment, processes, and chemicals with inherent hazards of high temperature, high pressure, flammability, and toxicity (Ayi and Hon, 2018; Ménard and Trant, 2020). An exploration of students' experiences in a research-intensive environment revealed that their relationship with research varies across different communities. Many students feel a sense of connection to, and participation in, a broader research community. However, some express frustration over how much research remains concealed from them (Ayi and Hon, 2018). According to Robertson and Blackler (2006), students recognize the significance of the connections between research, teaching, and learning, and they expect to engage with current research. Unfortunately, the nature of the research process is often obscured, leading to a lack of understanding regarding the role of research within the university and frustration over its perceived invisibility. Laboratories play a crucial role in fostering a sense of belonging and connection to research.

The scientific disciplines are traditional ways to cluster laboratories. The increase of multi-, inter- and trans-disciplinary research and multidisciplinary departments effect to research practices (Hakala, 2009). Laredo and Mustar (2000) wanted to enlarge vision of laboratories from dominating stereotypes of fundamental and applied research. Their research compass card points out the different activities in which labs are simultaneously involved: certified knowledge, embodied knowledge, participation to competitive advantages, participation to the development of new public goods or services, participation to public debate.

McCrory et al. (2022) state that lab types can be described based on characteristic differences in the foundational orientations. For example, *(Re-)Design and optimize labs* are constructed as bounded co-creation environments and framed at the level of user with a focus on technological challenges and needs. Technology is foregrounded as an enabler in achieving lab ambitions, often through the iterative testing of products and services. *Fix and control labs* share this emphasis on technology in ambition and foregrounding. In contrast, *Explore and shape labs* are constructed as shared explorations to grasp complexity at the level of systems. Methods and processes are foregrounded in these labs. *Educate and engage labs* expose a different orientation as educational learning environments, focusing on new forms of multi-stakeholder, transdisciplinary education (McCrory et al. 2022).

Whicher (2021) explains the typology of policy lab financing models and a lab proposition framework for establishing, reviewing and evaluating policy labs. The typology outlines four models for UK labs financing models – Sponsorship (funding from one or multiple departments), Contribution (labs recover part of the costs of projects), Cost Recovery (labs charge for projects on a not-for-profit basis), Hybrid (labs benefit from multiple income sources such as Sponsorship, charging and knowledge exchange funding) and Consultancy (labs charge a consultancy rate with a profit margin to expand operations). The Lab Proposition Framework comprises of four components (1) Proposition – the vision, governance and finance models; (2) Product – the offering, user needs and tools; (3) People – the people skills, knowledge diffusion and wider capacity building; (4) Process – the routes to engagement, user journey and promotion mechanism.

Based on econometric analysis Prince et al., 2018 proposed a typology that classified the labs into three clusters. Cluster 1 includes laboratories, which are intensive in technology research and development. Cluster 2 consists multi-activity laboratories. Cluster 3 includes research-centered laboratories. This investigation compared laboratories in Brazil. The study was continued by Aparecido and Kannebley (2021) and they investigated how different styles of research organisation with laboratories were related to scientific performance and patenting. They defined a typology with five categories of laboratories. The categories were defined based on team composition—represented by the participation of permanent researchers, postgraduate students, and technicians—and by the scope of activities.

An integration of physical and virtual research spaces, where researchers, through the virtual reality environment (VRE), move from one to the other has been investigated by Borda et al. (2010). The access to data, tools, computational resources and collaborators that virtual realities facilitate leads to faster research results and novel research directions. One can identify Collaborative e-Research Communities, Collaborative Virtual Environment, Collaboratory, (Science) Gateway, Virtual Organisation or Virtual Research Community. The VRE is the environment through which a researcher engages with, and becomes part of, a Virtual Research Community- However, they state that the term used was not important, though the understandings associated with the terms 'VRE', 'Collaboratory' and 'Gateway' are converging on a set of characteristic features: an electronic web-based environment for a) access to data, tools, resources; b) co-operation or collaboration with other researchers at the same or different institutions; c) cooperation at the intra- and inter-institutional levels; or d) preserving or taking care of data and other outputs. Migliore et al. (2024) investigated University Hubs as an opportunity for the development of future university models. These spaces can pursue

knowledge creation and sharing with diverse communities outside the campus boundaries, but they entail the risk of simply enhancing university visibility in different places without pursuing a true engagement with local communities.

McCrory et al (2022) investigated sustainability orientated labs. Labs, such as Urban Transition Labs, Challenge Labs and Real-World Labs articulate explicit relations to sustainability. This collection of labs embraces the view that there is an inevitably experimental, and experiential, nature to sustainability.

Berberi et al. (2023) state that living labs are promoted as an effective open innovation approach that accelerates the adoption of innovations and application to sustainability transitions. Based on the literature study, the perspectives to clustering research environments vary (Figure 1).

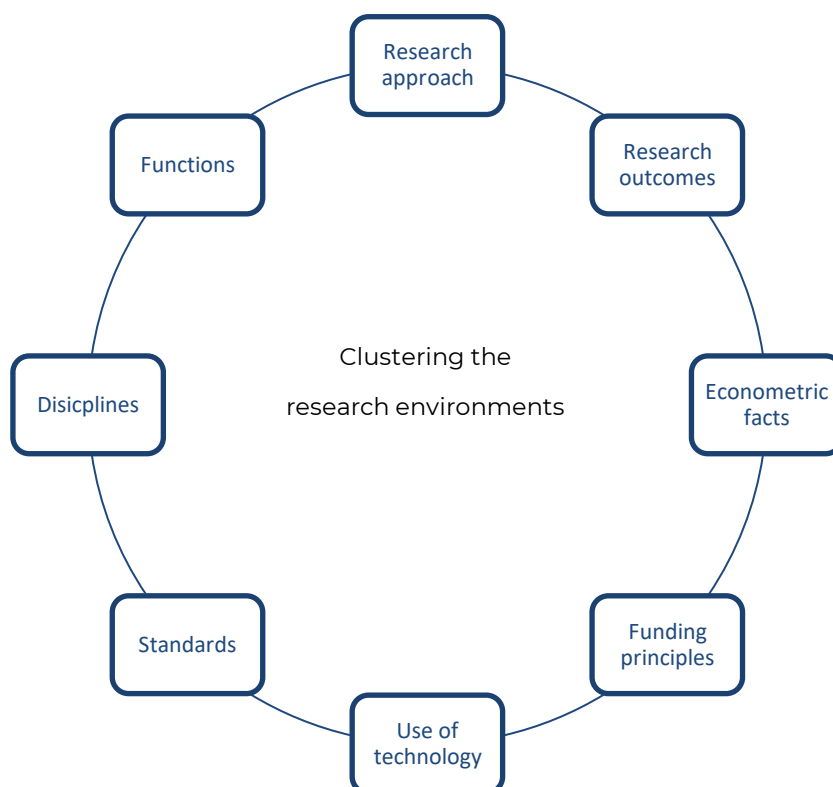


Figure 1 Different ways to cluster the research environments. Source: Authors' own work

Laboratories can be illustrated by standards, scientific discipline, research approach, research outcomes and productivity, econometric factors, funding principles, use of technology or integration of physical and virtual realities. The diversity of approaches is a rich starting point to identify the alternative way to cluster and categorize academic research environments and services for the use of facilities management. For facilities management it is important to understand the landscape of research environments to align with the core facilities. It is also a beneficial to find an overview and identify the how different research environments and services can or cannot be interlinked. The categorizing is still missing the deep and holistic user perspective, which is essential for facilities management.

METHODS AND DATA

The research design of this study is based on the empirically grounded typology method proposed by Kluge (2000). This descriptive method aims to arrange complex constructs and produce a typology. The process of creating typologies is iterative, involving assessment and classification of material

according to shared descriptions. Due to this iterative nature, researchers move back and forth between dimensions, cases, regularities, and types. The intention of this research is to develop a preliminary typology with a limited number of cases, while future studies will test and validate this typology with a larger sample.

The initial phase of creating typologies followed four steps derived from Kluge's process model (2000):

1. Identifying relevant dimensions for categorization.
2. Grouping specific cases based on these dimensions.
3. Analyzing grouped cases to understand their characteristics.
4. Defining potential parameters for each type.

Although the empirical data from the cases is still limited and preliminary, it provided sufficient material in the first trial to capture and test the dimensions and identify the positions of the cases. Additionally, literature on less holistic, thematic classifications informed the process. Participants in the focus group workshops included campus researchers from various European universities, as well as researchers, administrative staff, and support service experts from a Finnish university (Table 1). Criteria for participation included experience with research environments on the university campus, with some researchers actively engaged in campus-related projects and others involved in the development of research environments.

Table 1 Summary of workshops

Workshop	Number of participants	Focus	Expertise and background
1	24	Dimensions, grouping and analysis	International group of campus researchers
2	12	Dimensions, grouping and analysis	Internal university participants, mixed backgrounds from research to support services
3	6	Construction and characterization of types	Internal university participants, mixed backgrounds from research to support services

The cases were drawn from different universities and even different countries, and the selection in the first iteration was based on random sampling according to the participants' experiences. The defined criteria for a research environment included its connection to the university's research activities. The positioning of the cases was conducted based on specific dimensions, and the test fit provided an adequate basis for identifying the suitability of the four typologies.

The proposal for the parameters for different research environments was developed during the third workshop. The criteria for presenting five parameters were based on data saturation achieved during the workshop. Participants described the parameters, which were: Physical Structure, Technical Solution, Equipment, Services and Procedure of Use. These parameters can be weighted in each type of laboratories. It provides a basis to identify similarities and differences between the cases representing the types. The validation of the parameters will be made in the future studies with the higher number of cases.

RESULTS

The cases positioned to the typology are summarised in Table 2.

Table 2 Cases

Case number	Case	Representing the typology
1	Lab for teaching	Closed approach Loose structure
2	Lab for teaching	Closed approach Loose structure
3	Smart building	Closed approach Fixed structure
4	Specialize lab	Closed approach Fixed structure
5	Living lab	Open approach Fixed structure
6	Living lab	Open approach Fixed structure
7	Digital lab	Open approach Loose structure
8	Test bed	Open approach Loose structure

In the first phase, the typology dimensions focused on accessibility to lab environments and the location of research spaces. However, these dimensions did not sufficiently incorporate the digital characteristics of the lab environment, because the physical location had such a significant role in the typology. The next iteration introduced the renewed dimensions: closed versus open research environments and fixed versus loose structures. "Closed" as having restricted access to the research environment, while "open" indicated access available to a larger group of individuals. However, the term "access"—which denotes the ability to enter or utilize something—was deemed too limiting and replaced by "approach" in the final concept, as "approach" better captures the manner of engaging with a situation or reaching a destination. The structural dimension examined whether the built environment had a fixed structure or a more flexible, loose configuration. Although the perspectives of internal and external users were considered, they were ultimately excluded from the model, as they are context-dependent and can be addressed separately within each of the four typologies. Additionally, some specifications were made when the dimensions did not adequately address the aspect of virtuality.

Two dimensions - closed vs open approach and fixed vs loose structure - brought us to four typologies (Figure 1). They are:

1. Research lab: The special research environments
These research environments are based on laboratory experiments involving the testing of hypotheses by creating controlled conditions in a laboratory setting.
2. Teaching lab: The multi-use basic facilities
These research environments are typical facilities for teaching the laboratory experiments for the students.
3. Open lab: The movable research facilities

These research environments are real world environments providing both virtual and physical environments to share technology and create innovation.

4. Living lab: The flexible real-world environments

These research environments are ecosystems, which integrate research and innovation through co-creation in fixed real-world environments with open, dynamic processes.

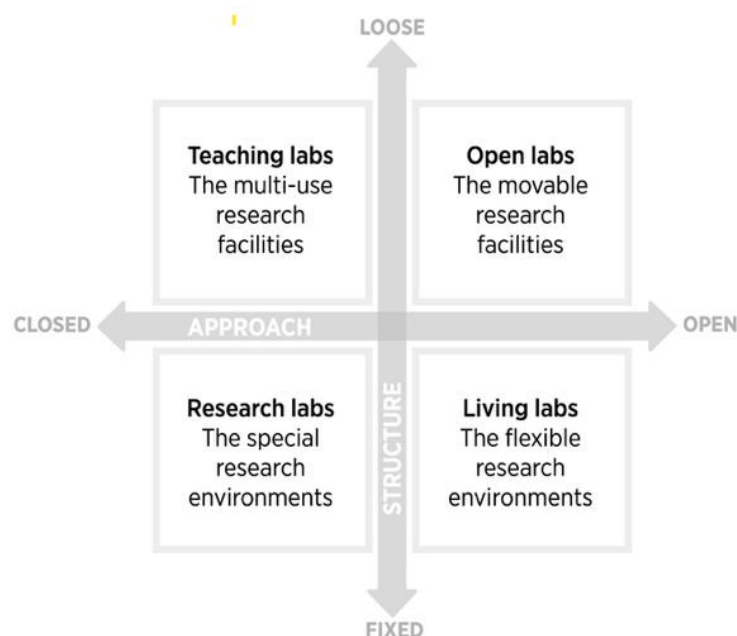


Figure 2 The typology of research environments. Source: Authors' own work

The framework of typologies can be used in multiple ways. It can help to identify the different profiles of research environments in the university. The different profiles set different requirements for the proposed parameters. It is important to note that, at this stage, the description of the different parameters in relation to the typology has not yet been completed. This means that the various profiles of research environments and their associated requirements have not yet been clearly defined or analysed thoroughly. *Physical structure* is a spatial solution in the built environment including different building technology solutions. The complicated entity of the *physical* and *technical solutions* will then serve as a platform for different research *equipment*. The fourth parameter is *service* parameter, which include the selection, level and user groups of services. The fifth parameter is the *procedure of use* in the lab environment. This is particularly important to clarify explicitly in multidisciplinary research laboratories. Additionally, it provides a way to identify the need to both align and differentiate the policies in terms of different user groups, e.g. internal and external users on campus. Incorporating this set of parameters can serve as a valuable checklist for considering essential factors when establishing, redesigning, or constructing new research laboratories.

DISCUSSION

The typology of research environments can open new and integrative perspectives to the topics facilities management is now investigating in university research landscape and services: safety, space utilization, sustainability, technology, user satisfaction and budget management to mention the most important aspects. Facilities management can benefit from the typology of labs both on demand and supply side. The complex research environments need technical solutions, which might be difficult to understand without the context of the research. To ensure that the demand of the research environments can be responded by the supply of the labs, the typologies, parameters and profiles help to increase the mutual understanding, to discuss about the same with issues with shared concepts and improve the quality of the research environments in the sufficient way.

The research contributes to scientific discussion about the significance of research environments in the creation of new knowledge. It is interlinked with knowledge management and innovation theories as well as research policies and higher educational facilities. The practical contribution aids in the design and planning of research environments. The more complex the research environment, the more important it is to ensure that different stakeholders discuss the same issues using the same concepts.

By using the typology to understand the research landscape of the university it is possible to create a more coherent and effective research ecosystem that enhances collaboration, resource management, and overall research output.

The findings of this research are inherently preliminary, as they are not yet supported by robust empirical data from the initial phase of the study. Nevertheless, they offer promising insights into the research question: what the ways are to categorize the research environments for research, development and innovation in the research university.

The limitations of the study are in the sufficient sample size to draw generalized conclusions. However, the first proposal of four typologies of laboratories can be validated with the larger number of cases. Additionally, five differentiating parameters serve as a starting point to distinguish the typologies and identify the profiles in a clear and unambiguous manner. With a larger sample more precise illustrations of typologies can be drawn, and one can identify also the significant relationships and tensions in between the typologies.

The limitations may cause the oversimplified proposals for complex research environments. However, to identify the typology, which aims to provide understanding for inter- and transdisciplinary research environments one need to start from the pure dimensions. This makes it possible to capture the complicated matter.

CONCLUSIONS

The complex research environments are affected by the increase of digital research environments. This phenomenon can be discussed further by using the typology. It might be possible to identify e.g. similarities and differences in the use of artificial intelligence for different purposes and with different ways in the four typologies. The elements that can be replaced by developing technology vary across different disciplines and research initiatives, including those with a multidisciplinary approach. One can use the technology parameter in different lab profiles with the way, which is also helping the integration of physical and digital research environments.

The pressure for the sustainable design and use of research environments is challenging while e.g. the special facilities use energy much more than the basic facilities on university campus. The typology and parameters can be used also for assessing the ways to balance the sustainability and increase the resilience of the research environments on campus and in the stakeholder ecosystem. Facilities management need to improve the efficient use of campus in a sustainable manner. The typology can be used also for profiling the sharing potential and responsibility of the research facilities in use and in maintenance.

The essential future step in the research is to reconfirm these findings by conducting larger-scale studies with the relevant number of cases to draw the more reliable empirically grounded typology. Based on improved typology it is possible to investigate the profiles of the typologies both from demand and supply perspective and use identified parameters as focus of the research. The widening of the research environments from lab-based solutions to wider context increases the understanding of the research environment volume for different collaborative activities, which take place within or between the disciplines and among different stakeholders. The typologies provide a map also for identifying the research environment concepts in between the pure typologies.

The typologies and parameter-based profiles need to be researched for

1. large scale campus development with the potential of smart campus solutions
2. innovation models with different physical and digital stakeholders on university ecosystem
3. responding to the needs of inter and transdisciplinary research
4. improved facilities management on campus and increased dialogue with core services of the university
5. responding to the changing needs of research processes due to digitalisation: infrastructure, platforms, systems, equipment and tools, practices and use
6. increasing the awareness of resilience connected to laboratory environments including the energy costs of artificial intelligence.

The inspiring research avenue can be found by integrating the strategic significance of research environment, changing user needs, the elements of sustainability with economic, ecological and social aspects as well as linking this with financially vital elements. The typology can support at its best the interest to approach the research environments as strategic tools for the universities.

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Supporting Sharing in the University Library

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ABSTRACT

Background and Aim. The essence of libraries is about sharing. Finnish academic libraries offer resources, facilities and services to all citizens. This study explores the sharing culture in co-produced services related to the learning environments and how different organizational structures support or hinder the sharing-based services in academic libraries.

Methods and Data. The interviews were used to explore how library staff experienced the sharing of library spaces/learning environments, the co-production of library services, and the collaborative development of shared practices. The interviews explore what encourages sharing and collaboration, and how structures act as barriers. All interviewees were asked the same, open-ended questions. After these questions there was the opportunity to expand their ideas about the sharing in libraries. Qualitative data was analyzed by using thematic analysis to identify sharing patterns, principles and shared services. In addition, the data will be categorized based on the governance models and the role of facilities management.

Results. Data shows how the library staff sees sharing; that is, how different governance models and sharing network relationships with partners affect the success of the ways that the service is organized.

Originality. Academic libraries and new learning spaces are a novel focus especially in the context of facilities management.

Practical Implications. Guidelines for library core and support services and their role in transforming the culture of sharing is a value for campus facilities management.

Type of Paper. Full research

KEYWORDS. academic libraries, campus, learning environment, sharing, services

INTRODUCTION

University libraries are built on sharing: sharing knowledge, sharing services and sharing facilities for the multidisciplinary research community. Collaboration between libraries, academics and other stakeholders, like facilities management, forms the basis of a culture of sharing and it ensures equal access to library resources and services for all students and staff. Through the years libraries have usually collaborated in resource services in the university organisation. Interlibrary loans have expanded library collections to the benefit of both users and libraries. Given the significant role of sharing in the core operations of a library, it is important to explore how facilities management can support the effective use of shared resources.

Libraries are evolving towards learning hubs providing facilities for people to work together, to socialise and to meet in formal or informal ways (Curvelo & den Heijer, 2011). The informal learning environments on campus are needed even though the collections, information retrieval and other services are available digitally. The changes in the ways that the university library is serving its customers require the skills to use modern technology as well as the skills of the community manager. Identifying the services needed from facilities management in this situation opens new possibilities for producing services together with the university library.

This study explores the sharing culture in co-produced services related to the learning environments and how different organizational structures support or hinder the sharing-based services in university libraries. In particular, the study focuses on the facilities and their utilization; the services that are provided within these facilities; and the role of facilities management in the culture of sharing. This study employs multiple foci in exploring the experiences and expectations of the library staff about sharing and collaboration.

FRAMEWORK FOR SHARING AND SUPPORTING SHARING – UNIVERSITY LIBRARY

The shared use of facilities has gained new interest in general through the sharing economy (Brinkø et al., 2015). In the private sector this can be seen as a business model where consumers pay for the function or utility instead of owning the products, which can lead to more efficient use (Ranjabi et al., 2018). In the public sector, the sharing of services includes a business model for reorganising the traditional ways of using the facilities and producing services. Physical places that are designed to support certain activities encourage (intended) behaviour patterns and this behaviour, in turn, maintains these places. The library or lecture hall are well-known examples, where places and behaviour stabilise each other over centuries, for instance being quiet and reading concentratedly or being an attentive listener when lecturers speak (Ninnemann et al., 2020). The library facilities or the library as a learning environment is one of the key library services (Leung et al., 2022). Facilities management supports both the existing and new ways to use shared resources on the university campus.

Brinkø et al. (2015) have defined the shared use of facilities based on: a) the openness of the community; b) the types of shared facilities; c) the access to the spaces; and d) the size of the user group. The field of space management is linked to the topic of shared spaces, with space being the physical object of the sharing, and facilities management works with two different types of space, core space and support space (Brinkø et al., 2014). They continue with the typology, which illustrates four types of sharing: 1. Sharing a specific facility – e.g. a work-space – in a semi-closed community; 2. Sharing of several facilities in an open or semi-closed community; 3. Sharing physical space in a building or a building in a closed community; and 4. Sharing facilities between a network of buildings/organisations in a closed community. The university library is typically shared in the university community with the intention to be open also to the society around it. Each typology also has a different perspective on requirements for facilities management.

Poutanen & Nenonen (2024) claim that there are three thematic clusters for shared spaces on a university campus. One cluster illustrates the sharing on campuses as based on the user groups, the time/length of use, and the access option. The others focus on workspaces. The relevant cluster for this study is university organisation-related environments, which consist of spaces that support interaction within and between units and faculties. These environments also include spaces that are shared with the whole campus community, i.e. are intended for all, such as academic libraries, restaurants, learning centres, and other open-access learning spaces. O'Donnell & Anderson (2021) have shown how university libraries have a range of versatile learning and study spaces, and they utilise the rapid advances in digital technologies. Libraries are widely supporting the changing practices in research, teaching and learning. When libraries depart from the practices of the traditional library services, the collaboration with other university stakeholders and partners makes these new services and practices more successful.

Examples of sharing in university libraries could include sharing spaces, co-produced library services, collaborating to develop shared practices within the campus community and facilities management. According to Brinkø et al. (2014) the typology of sharing can be categorised from five different perspectives: 1. What (referring to the object of use); 2. When (referring to the time perspective); 3. Why (referring to the reason behind the sharing); 4. Who (referring to between whom the sharing takes place); 5. How (referring to how the sharing is organised).

The alignment of processes in the short- and long-term set the enablers and maybe also barriers to sharing. Libraries, which are usually found adjacent to schools and universities, often share the same schedules and semesters as their stakeholder organisation. The academic library accounts for the learning, teaching and research support of the institution (Leung et al., 2022). However, the academic year sets the requirements for the library too. If the practice of the academic year needs to be re-considered, it is good to identify, as Brinkø et al. (2014) suggests: What is the role of time, when the services are shared? Is there a difference if the sharing is simultaneous, where different organisations offer the service at the same time, or the sharing is seeing where one organisation is responsible for the service during some hours of the day and another organisation during other hours of the day.

Although library services are based on sharing, with a new service or sharing openings there are always specific reasons for sharing. From a library perspective, sharing, providing and co-producing services and working with partners also comes to the fore in terms of sustainability and responsibility. "It can be considerations regarding costs, increased sustainability by sharing resources, or a hope of creating synergy or agglomeration effects to mention some" (Brinkø et al., 2014). Academic libraries have the responsibility to provide innovative services and access opportunities and learning resources to serve the information needs of all students to achieve learning objectives (Munster et al., 2017).

The increase of digital teaching and learning options provide students greater access to remote resources and services through library online platforms (Atuase et al., 2024). Although COVID-19 may have accelerated experiments with digital learning, this may have also reinforced the ongoing value of face-to-face teaching and the campus experience (Cox, 2022). Digital platforms do not completely replicate the experience of a physical library, which encompasses top-notch learning amenities, dedicated study areas, expert library staff support, and a tranquil setting conducive to collaborative learning (Atuase et al., 2025). Cox (2022) presents a holistic review of the factors shaping the use and design of library space that will be operating in the post-COVID-19 period. They propose thinking about the library in the context of wider campus trends rather than seeing library-specific factors as predominating. They list strongly emerging trends, which concern student well-being, sustainability, equality, diversity and inclusion, and decolonization; increasing co-design with students; and new technologies.

"How sharing is organised?" is connected to the need of academic libraries: it is important to collaborate with other stakeholders to provide students with needed skills, accessible learning spaces, technologies and resources – also the means of resource sharing between libraries (Atuase et al., 2025). Collaboration is the avenue to exchange knowledge and experiences, resources, and skills, and provide space to improve the quality of their services (Atkinson, 2019). Brinkø et al. (2014) note that the most difficult category to describe is how the sharing is being undertaken. There are many ways to organise the sharing. It is also the most relevant for how the sharing works in practice and what kind of practices there are for counselling and managing. The sharing economy facilitates access-based consumption (Curtis & Lehner, 2019) that in the built environment can be seen as the short-term or flexible lease of spaces or spaces with a type of sharing aspect (Lundgren, 2023). For building users, the tangible benefits include, e.g., lower costs and a high quality of spaces. The social interactions include, e.g., the importance of group cohesion. (Francart et al., 2020.) Additionally, Francart et al. (2020) identified a third aspect related to the internal organisation of the space-sharing community, which includes, e.g., decision-making practices. Lundgren (2023) discovered that incorporating shared spaces in adaptive reuse projects contributes positively to, e.g., social sustainability, predominantly through creating the so-called 'vibe' and 'tribe'.

METHODS AND DATA

The study is based on qualitative data. The thematic interviews are used as primary data. They are conducted with the small library staffs from several libraries in the capital region of Finland. The interviews focus the experiences and expectations of the interviewees. The theme of the interviews is library services related to facilities and, above all, learning environments.

Three university libraries were selected for the study: Aalto University, the University of Helsinki and Metropolia University of Applied Science. Additionally, one branch library of the public library section, Viikki City Library is participating, because they are sharing the same building as the Viikki Campus Library (Helsinki University Library). While this article presents an analysis of the thematic interviews, a subsequent focus group workshop will yield complementary data for future work. Moreover, the focus group will take into account the same universities and libraries as the present interviews do.

The criteria for choosing the libraries are their location in the capital area, and the three types of relations they have to the parent/partner universities: an independent unit, an integrated unit and a rent-based partner-relationship (Table 1). At this point one interviewee from each library was chosen. Their positions in the library were analogous: they are all head of customer services and responsible for the learning environments. They have a good place in which to observe the co-operation and sharing in practice. When conducting thematic interviews with library staff, there are several key considerations to keep in mind to ensure that the data collected is meaningful and comprehensive. All interviewees were asked the same, open-ended questions. After these questions there were time and opportunity to expand their ideas about sharing in the library facilities.

Three interview sessions were made face-to-face, one on-line in a Teams-meeting. Each interview was conducted in Finnish and took 40–45 minutes. The interviews were recorded, and all the informants were informed about the purpose of the interview, and their consent was requested.

Table 1 Libraries/learning centre and relation to the parent/partner university

	Library/learning centre	Relation to the parent/partner university
A	Viikki City Library	With a rental contract on the University of Helsinki facilities, a part of the Culture and Leisure Division in the City of Helsinki organisation
B	Library of Metropolia (University of Applied Sciences)	A part of the Research and Development unit in the University of Applied Sciences
C	Helsinki University Library	An independent institution of the University of Helsinki
D	Learning Centre of Aalto University	A part of the Learning Service of Aalto University

The interview questions followed the framework and typology of sharing facilities (Brinkø et al., 2014):

Q1. **What** are you sharing? Can you describe any specific examples of what your library is sharing with other organisations? Can you provide examples of services that are shared with other entities?

Q2. **When** are you sharing facilities, services or practices? Can you provide examples when the sharing is more common or important than at some other time?

Q3. **Why** are you sharing? Benefits? What positive outcomes have you observed from sharing these spaces? What advantages have you seen from sharing or co-providing these services? Challenges? What obstacles have you encountered in sharing library spaces, and how have you addressed them? What difficulties have arisen in the process, and what strategies have you used to overcome them?

Q4. **Who** is sharing, who has initiated it and who are the partners?

Q5. **How** are you developing the shared practices collaboratively? Can you describe any specific initiatives or projects that illustrate collaborative development?

Initially, the discussion focuses on the perspectives of library staff regarding the concept of sharing within their libraries. The interviews explore what encourages sharing and collaboration, and whether

the organisational structures act as barriers. At the beginning of each interview was a discussion about the organisational structures of the libraries involved. Together, we pointed out the specific context and operational nuances of each library. Often the discussion started from the question of what sharing means, whether it is the same as cooperation with other actors. Library services and sharing seemed at first to be a challenging concept, because the whole service is based on sharing. During the interviews there were discussions outside the questionnaires on how library staff experienced the sharing of library spaces/learning environments, the co-production of library services, and the collaborative development of shared practices. Although there was an assumption about what would be left out of the study before the interviews, and the study focuses on the point of view of facilities management, the interviewees were allowed to openly list what and how something is shared in their libraries.

The interviews produced qualitative data, which was coded according to three principal themes grounded in the activities of libraries and learning centres: 1. The facilities and their utilisation, 2. Services provided within the facilities, and 3. Support services. In the second level of analysis (Table 2) the data was examined by using thematic analysis to identify sharing patterns and principles and shared services especially concerning the role of facilities management in library/learning centre services.

Table 2 The second level of thematic analysis

Coded concepts about shared services	
1.	Learning environment, safety, lobby services, and opening hours
2.	Customer service desk
3.	Computers and other equipment for students
4.	Events
5.	Working place for staff
6.	Other services

In the third phase, the data was categorised on the basis of governance models, which revealed the different ways of organising the relationship between the university and the library.

RESULTS

The thematic interviews yield rich and valuable data on how library staff experience collaboration and sharing in their work environments. The themes from coded analysis of the co-produced, shared service in library/learning centre facilities are the following:

Learning environment, safety, lobby services, and opening hours

In all the discussions, a shared library space came up right from the start. They are shared with all customers – university community, citizens, and visitors. The space as a service is produced together with other service units, like facilities management. Usually and in most cases the library delivers the learning and study places. The Information technology (IT) unit oversees computers. Facilities management provides lobby services, defines the opening hours and oversees safety and security services. In some cases, there are start-up hubs or cafés in the libraries/learning centres. They are operated either by a private company or by a university department. In these cases, there are more partners with whom must negotiate the rules and the level of service. Library facilities are needed as much now as before the pandemic era. Information specialists and their expertise are not significant concerning the library facilities. It requires a different kind of professional skill: there is a need for security and lobby/hospitality services. The library has changed more towards a self-service library when the facilities management has come more crucial. Throughout the discussions, it was emphasised that collaboration with the facilities management department is essential for the library. Design work, furnishings, cleaning, lobby service, property maintenance related to space renovations

are by far the single most important support services. The best results and success are achieved when the divisions cooperate closely and co-develop the services together.

Customer service desk

The customer service desk is shared with other operators in some libraries. The University Library, the City Library and the Lobby Services share the same service desk area on the Viikki campus. Some services can be provided by anyone at the desk, while most services can only be delivered by individuals from the service owner unit. This can be very stressful for both customer service staff and customers. Successful shared use of a customer service point requires a common agreement and way of dealing with customers, as well as clear guidance for customers. Libraries traditionally receive good feedback on their customer service. The library and lobby services could intensify cooperation in customer service expertise and take care of the customer experience together.

Computers and other equipment for students

The learning environments have computers and other devices for students. Information technology (IT) units usually provide the devices to the libraries/learning centres. It is important to decide together what the number of computers and printers is. Although neither the library nor the facilities management department provides computers, employees from both institutions offer guidance on their use and placement within the space. Once again, ongoing discussion and co-creation among all stakeholders are essential processes for the success of the service.

Events

University libraries rarely organise events independently, aside from guidance-advising sessions related to information seeking and management. Instead, they typically participate in organizing events by providing space, while the content is developed by entities such as degree programmes, the Viikki City Library, and the start-up community. However, challenges have been perceived, including e.g. unclear agreements and the unsuitability of the space for events, particularly concerning the acoustic environments. On the positive side, events bring life to libraries. At events, e.g. safety and hospitality must be considered. Therefore, facilities management should be involved from the planning phase to ensure successful execution.

Working place for staff

Library staff share workspaces with other actors at the university for instance, the break room and working places. The workspaces need to be designed and co-developed in collaboration with library staff and facilities management. It is essential to listen to the users, as library work is continually evolving and the requirements for workspaces have become more diverse. For example, some staff handle printed materials, others work with electronic resources, and some organise student-guidance events.

Other services

There were some other themes, which also emerged from the discussions. Expertise and competence are shared across functions and units. The new services for research will be produced in cooperation with the library and other university units. Digitalisation has increased collaboration and facilitated cooperation. Digital customer service via the ticket system can be integrated across all university services. The interviewees also discussed the services which can be provided together at everyone's own location: three Universities of applied science in the capital area have united their printed collections. The library card owner can order material from one to another. As a counter example, one campus library had two separate collections: the city library collection and the university library collection. Users need two separate library cards although the library seems to be one merged learning environment. Additionally, the IT-services and applications may be different and cause digital boundaries between the stakeholders.

To summarise the topics for the framework questions, the results highlight the importance of collaboration and shared responsibilities among various stakeholders in managing library services

and facilities. An active and practical collaboration ensures a positive experience for all users. The objects of sharing include library spaces, computers, other devices (like printers), and customer service desks. Additionally, events and services are also shared resources. The reasons behind sharing include enhancing customer service, improving learning environments, and fostering collaboration among different service units (like facilities management and IT). Sharing is also driven by the need for safety, effective use of resources, and providing comprehensive support for the university community, including students and staff. Sharing occurs among various stakeholders, including library staff, facilities management, IT units, other university departments and the broader university community. The sharing is organised through collaborative agreements, co-development of services, and ongoing discussions among all stakeholders.

Additionally, shared services were clustered on three categories related to the governance model of the library and the university.

A. The library operates as an independent unit within the university.

When the library functions as an independent unit, it is responsible for its own resources and can take the initiative in fostering sharing and collaboration. If the library is unable to find the partner from the university or partner organisation for free, in principle, it can purchase the necessary service. However, the same independence can also be a hindrance, while the sharing should always lean on the agreements. Each unit has its own goals, and they may differ from each other without any alignment. Facilities management is a collaborative partner and some of the services can be outsourced.

B. The library services are integrated into the university organisation

When the library/learning centre is integrated into the university departments, the library services may be found in many different locations in the organisational structure, such as learning services. The integrated position helps sharing as it allows for the use of the same resources and alignment with common strategic or tactical objectives. However, if the goals from a learning-environment perspective differ, there may be limited opportunities for collaboration. Facilities management is integrated and provides services as one unit among others at the university.

C. The library has a rent-based partner-relationship with the university.

In this model a contract clearly outlines what the units can share and how they can collaborate. The contract guides official cooperation, ensuring that both parties understand their roles and responsibilities in the partnership. The potential for sharing is part of the negotiations about the content and quality of the services. Facilities management can have a role with the rental arrangements or serves according to the service agreements included in the rental agreement.

Each of the three models present unique advantages and challenges for collaboration and resource sharing. The first model allows for flexibility but may lead to isolation, while the second model fosters alignment but can limit collaboration if goals differ. The rent-based partnership provides clear guidelines for cooperation but relies on contractual agreements to define roles and responsibilities. Understanding these dynamics provides determinants for understanding the sharing culture and sharing potential.

DISCUSSION

This study explores the sharing culture in co-produced services related to the learning environments and how different organisational structures support or hinder the sharing-based services in university libraries. Based on data, research literature and the previous observations/experience of library work, the libraries understand the benefit of a sharing economy in practice. They are committed to share the services and the competences for the customers and partner units. The conceptual bias emerged in the discussion: on the level of practical work and everyday life, some interviewees prefer to talk about cooperation rather than sharing. Sharing as a term or theoretical background felt disturbing, as in practice we were mainly talking about services produced together. Brinkø et al. (2014) have bundled the sharing economy and collaborative economy or collaborative

consumption under the same phenomenon. It would be useful to identify the similarities and differences between the two economies in the context of the university library.

The university library has different types of spaces to share: shared workspaces, customer spaces or shared space-related services (Sankari, 2019; Poutanen & Nenonen, 2024). To increase the space as service attitude one could focus on new professional roles: hosting of shared services and spaces. The role of community manager or host could focus on organising social activities and on creating connection between all the stakeholders and their customers (Sankari, 2019; Lundgren et al., 2022). The library/learning centre and other stakeholders can concentrate on developing the service and ensure its continuity (Kyrö & Lundgren, 2024). The hosts or community-managers' team could be the new joint team, not a new department. It would be interesting to open a conversation about the differences between community managers and lobby services, which are traditionally provided by facilities management. Library professionals, student counselling, student peer hosts and lobby attendants are the first persons to receive customers in the shared informal study space in the investigated libraries. Challenges arose from the different customer service culture, the guidelines and principles of the different background organisations. Agreements and common operating models would make the work of the staff easier and improve the customer experience.

The limitation of this study is in generalising the results due to the study's small sample size. However, the paper is a good starting point for widening the sample size. Additionally, one needs to be critical toward the narrow representation of the organisations in the interviews. To have enough diverse perspectives it would be important to also include people from facilities management, the administrative levels among future interviewees.

The validity of this study would have increased if the customers could have their voice heard in the interviews. The perspectives of customers using shared-service are now lacking from the data. In principle, they use a service that is common to everyone in this context, also free of charge, where financial ownership is not important from their perspective. The concept of a student as a customer is a guiding idea within the developing library services (ODonnell & Andersson, 2021). The libraries collect significant amounts user data, and one could consider using that as secondary data. The contextual limitation may also arise from the representativeness of the chosen libraries. One can consider if the location of the libraries is a parameter which influences the results. It might well be that the location and societal traditions have an effect on the potential for sharing to a greater degree than this study has yet been able to identify.

CONCLUSIONS

The study maps the complexities and potential of sharing library services and spaces within a university context. The focus of the study is on the practical benefits and barriers to sharing and collaboration. University libraries and the university itself is in the main role at the core business of the library, where the services are fundamentally based on sharing. However, other service units of universities like facilities management can be supportive. This study did not touch economic benefits, however, so it is important to keep this in mind.

Sharing and collaboration can often begin for practical reasons: by the renovation of old premises or the design of a new space, changed customer needs, strategic goals and economy or by larger changes as during the COVID-19 pandemic (Atuase et al., 2024). The large-scale themes of sustainability and responsibility are recognised and understood in sharing, but it did not emerge as an initiating factor according to interviewees. Facilities management and other stakeholders could more openly communicate to the users that the shared-services is one way to promote sustainability and responsibility. The shared-services practices and models at the university is still at a premature stage. The professional facilities management practices could provide new sharing practices and patterns which could be applied and learned to use in university units. The sharing practices are taking shape among different stakeholders. They are easier when services are produced together within the same organisation, because the strategic goals are also shared and mutual and all actors

are aiming at the same goal. When the service providers are in different organisations, it is possible that the co-produced services diminish the borders between separate organisations. In the case that the library acts as an independent unit, it can complement its own service with a purchased service, such as a security service in the evenings. This brings in the third party to the ecosystem of sharing.

The framework questions sharing what, when, why and who have helped us to get hold of the sharing phenomena in university libraries. The main challenges concerned responses to the question of how to share. The discussion about incomplete or mainly oral contracts indicated that developing clearer contracts, aligning organisational goals, and creating standardised frameworks for collaboration are needed. The obstacles and challenges of sharing are most common when the parties of the sharing represent different organisations. Resources and operational goals differ, and unpredictability and long-term planning is challenging. Addressing such challenges could help in developing more effective partnerships. This research will proceed with focus-group workshops to further analyse interview findings. A second round of interviews will follow based on workshop insights. Future research will explore the role of facilities management in enhancing sharing potential as well as the impact of the library learning environment on student success. Additionally, examining co-production and shared-services models from various industries could provide valuable insights for library practices. Cross-organisational collaboration is essential for fostering a culture of sharing.

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Groups, Identity, and Academic Workplaces

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ABSTRACT

Background and Aim. This paper examines the team and community perspectives in academic workplaces to illuminate hybrid work practices and their spatial implications. Recent literature has indicated that hybrid working has impacted teams and communities, influencing social connections and a sense of belonging.

Methods and Data. The study examines two case universities and consists of three stages. First, the different team or community levels were identified based on open-ended survey responses, followed by semi-structured interviews with supervisors in University A. Secondly, the identified levels were tested at University B. The results were formulated incrementally through a qualitative content analysis process.

Results. The findings illustrate four team behaviour patterns and categories, each with different implications for on-site workplace spatial practices. The results indicate that team leaders, research and teaching practices, group cohesion, collaboration, and bonding needs and preferences all influence work manners and locations. Formal and informal collaboration are also key determinants.

Originality. Academic work is typically considered from an individual perspective. This study focuses on the team-level use of space and hybrid work arrangements.

Practical Implications. The results benefit the design and development of work environments by showcasing spatial requirements for on-campus activities that foster social connection, bonding and a sense of belonging.

Type of Paper. Short research

KEYWORDS. academic workplace, community, spatial needs, team, work manners

INTRODUCTION

Working alone and working together have been the focus of researchers on productive knowledge work and workplace management for years. Interest has been aroused as systemic changes in work and life have occurred due to the pandemic era. The hybrid work model encompasses two dimensions: working alone or in teams at different locations and engaging in synchronous or asynchronous activities (Vartiainen & Vanharanta, 2023). However, working synchronously at the same place is now more driven by collaborative work than it used to be. Still, team-based knowledge work remains under-researched, with primary focus on virtual teams (Ninnemann et al., 2024). There are interesting findings about the reasons why people choose office or home (Haapakangas et al., 2025), but there is less research on whether the choice is made collectively as a team. Additionally, the work environments in an academic context are under-researched (Indergård & Hansen, 2022).

This paper examines the perceptions of end-users in universities regarding their sense of belonging to a team or community, and how to identify different team patterns in hybrid work environments. The main research question is: What team or group patterns can be identified in hybrid knowledge work on university campuses? To address this question, qualitative data were collected and analysed from open-ended survey responses and interviews. The data was gathered as part of the workplace change processes in two universities.

LITERATURE STUDY

Hybrid work has advantages over fully on-site work (Aksoy et al., 2022). According to Aksoy et al. (2022), hybrid workers have higher job satisfaction and lower redundancy rates. Then again, according to Hassel's (2022) report, employees who spend more time at the office tend to be more satisfied, and fewer resignations have been observed among them. Employees are more engaged and have a stronger sense of belonging to the community and mutual trust in the work community than those who work remotely alone (Hassel, 2022).

Studies have shown that the shift to remote work has altered group dynamics, identities and well-being within academic institutions (Zike & Illingworth, 2023; Clementine & Qutieshat, 2025). The lack of in-person interaction has led to challenges in maintaining a cohesive group identity among faculty and staff. The evolving landscape of professional identities in academic organisations reflects a complex interplay of collaboration, space, and the redefinition of roles. (Vales et al., 2023.)

In comprehensive work environment literature, scholars such as van der Voordt and Jensen (2021), Brunia et al. (2016), and Danielsson and Bodin (2008) present evidence that the workplace and its physical factors affect perceived productivity in various ways. A healthy working environment that supports well-being and productivity depends on the ways of working and the preferences of the users. Satisfaction with the workplace depends, in particular, on user preferences regarding the balance between privacy and social contact.

Van den Boogert et al. (2024) state that although the most important activity of a knowledge worker is often seen as work done alone at the desk, over 80% of respondents also found scheduled meetings important for their own work. Haapakangas et al. (2025) investigated the push and pull factors of the office, stating that workplace experiences were mainly a push factor. However, Appel-Meulenbroek et al. (2022) found that employees who conduct independent tasks prefer home, whereas employees who conduct firstmost meeting-based tasks prefer the office (Appel-Meulenbroek et al., 2022). According to Lin et al. (2023), remote collaboration generates fewer breakthrough ideas compared to close research collaboration, regardless of the field and size of the groups. In decentralised teams, cooperation focuses on the final stage and explicit tasks (Lin et al., 2023). Ninneman et al. (2024) have formulated three distinctive knowledge work activities in teams: 1. Individual Work, 2. Team Work, and 3. Team Exchange. They continue to categorise teamwork according to the place and time. Indergård and Hansen (2022) have stated that university knowledge work is more complex than traditional knowledge work. It encompasses silent work, administration, teaching, and student guidance – the variety of tasks is vast.

METHODS AND DATA

The study investigates end-users' perceptions of teams in two universities. Both universities, A and B, are multi-disciplinary and located in Finland. The findings follow an inductive logic and are qualitative, based on content analysis and model validation.

The research process consisted of three stages and matching data sets. The first and second stages were conducted in University A. The first stage and data set consist of open-ended responses collected through a workplace survey conducted in 2022 for both academic and administrative staff at the university. The study includes open answers from two faculties (number of analysed answers: 251).

The second stage and data set entail semi-structured interviews conducted in fall 2023 with supervisors (n=25) of a faculty. The question set asked the supervisors' views on their workplace needs regarding both individual team members and team behaviour and activities. The third stage focuses on validating the "Team working" model at University B. During the interviews, nine research group leaders positioned their groups within the model, employing three themes: group identity, spatial solutions that supported them, and practices of sharing the workplace. The interviews were recorded and transcribed. The themes of the interviews included community, usage rates, sharing, fluent daily life, and other issues.

RESULTS

Group identities

The first part introduces the identified 'group identities'. According to our findings, university employees have diverse needs and preferences. Additionally, their needs and preferences are influenced by the extent to which the workplace, community, and team support them. The data also show significant field-specific differences in the role of work communities and their organisation, e.g., the unit, subject groups, or research groups in an individual's work. The data revealed that while the participants reflected their individual needs and preferences, they also constantly reflected these in relation to others. Based on this observation, we have identified four rough 'group identities' from the responses. Table 1 presents the 'identities' from an individual's viewpoint, i.e. whether they associate themselves with belonging to a group (or not). These group identities may be situational, meaning they fluctuate depending on the task and situation, and an individual can simultaneously belong to multiple identities.

Table 1 Group identities

Group type	Description
No Group or Group Elsewhere	Work independent within host university, person's networks are national or international. The group identity is in networks, the organisational unit provides more administrative support.
Varying Group	Collaborates with different instances within their host university depending on the task. Individual feels they belong to their unit or study field. Diverse groups foster a sense of belonging.
Tight-knit Group	Members work closely together in research, requiring interaction with colleagues on daily basis. A certain group is the core of belonging.
Multi-locational Group	Members work together remotely, located in different places. Some work on campus. Online working practices support group cohesion and a sense of belonging.

The first identity is No Group or Group Elsewhere, where an individual works independently at their university but has national or international networks. I.e., their collaboration is mainly outside the host university with other universities or industries. An allocated room or a dedicated workstation often meets workspace needs. The individual may wish to socialise with their colleagues in the break rooms.

The second identified group identity is a Varying Group. In this situation, the individual can switch between groups flexibly and relate to belonging to different groups depending on the tasks at hand. For example, an individual may initially feel a sense of belonging to their own unit or subject field (in teaching), which defines the group identity, and this identity may fluctuate depending on the topic at hand. As this group identity is ambivalent, the group includes people who may work in very different ways. Thus, the workspace needs vary accordingly.

The third identity relates to a *Tight-knit Group*, whose members work closely together in research and teaching, primarily on campus. People working in the group require face-to-face interaction with their close colleagues for work tasks. For example, experimental research work brings members to campus, i.e., their work demands their presence on campus, and in turn, this emphasises their sense of community. The members in this group type may have their allocated rooms or all work in a shared office.

The fourth group identity concerns *Multi-locational Groups*. The group members work from various locations; some are based on different campuses within the host university, while others work remotely, and a few remain on campus. In this group, the group leader often works remotely and has established remote working practices. However, individuals working in a multi-locational group, but on campus, may be physically isolated from the broader campus community.

Next, we identified two determinants which define the joint team patterns. The first considers how aligned the group members' preferences are (X-axis). The second considers how strong the cohesion of the group is and their need for interaction with each other (Y-axis). As presented in Figure 1, the team patterns have a slight view of the work environment choices, which can be typical for the team.

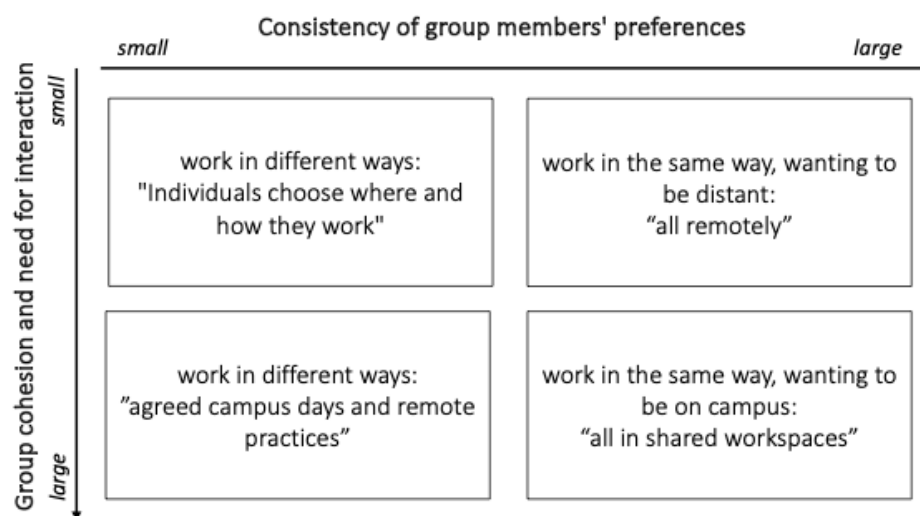


Figure 1 Team working patterns between two determinants. Source: Authors' own work

Validation with the research group leaders provided additional data to propose typical workplace behaviour for the groups. The interviews also provided data about typical sharing practices.

1. Thematic groups are like tight-knit groups which operate both internally and externally, creating a desire to participate in them; the groups have developed practices for strengthening peer support (e.g. seminars), which will be implemented face-to-face or hybrid after the pandemic. They utilise the environment in multiple ways and have already established effective practices for sharing. For them, there is a social driver for sharing: "It is important that we are not coming to campus because of us but because of the research community."
2. Varying Groups are functional groups which operate internally and anchor place-based. They are also faithful to norms and regulations; for example, they state that research is not the primary determinant of teaching, but rather the national degree structure sets the content. Functional groups perceived sharing as somewhat hindering their activities. According to an interviewee, "*There used to be more community feeling with the students when they were allowed to come into faculty places.*"
3. Administrative tasks ultimately do not form a group, or if they do, they are internally functional, or they work independently, loosely related, and it is difficult to join them from the outside; this makes them multilocal. Administrative groups were aligned with the functional groups – the tasks did not require them to share facilities, so they could remain as they had been. As one interviewee said, "We share meeting rooms and break areas – that is enough."
4. Multilocal groups are often network groups, e.g. in projects where actors in other countries individually focus on advancing science. Network groups are highly dependent on digital functional connectivity. The question of sharing within the campus community was not relevant for them. "*Well, maybe not sharing, but what about borrowing – someone can borrow my room when I am away.*"

DISCUSSION

This study highlights the diverse group identities in academia based on end-users' perceptions of belonging and how these identities influence workspace choices at the group level. The findings reveal that end-users with no group identity, belonging to network groups, and primarily collaborating with external partners, have needs for more individual workplace settings, similar to those of administrative groups. In contrast, those in a varying group collaborate within their community based on tasks, leading to diverse, community-oriented spatial needs. Tight-knit groups, characterised by strong social connections, also require group-based workplace settings that incorporate both individual and social work environments. Meanwhile, the spatial needs of multi-locational groups have diminished due to remote and hybrid work, making the need for on-campus workplaces scarce.

The study's limitation lies in the generalisation of results; however, it provides a framework for further investigation into academic and team-based workplaces based on these identified categories. Additionally, one needs to consider how team-based workplace patterns can be identified in a relevant way, striking a balance between individual and group preferences.

CONCLUSIONS

This study focused on identifying the group identities associated with the workspaces offered on a university campus. The findings illustrate team behaviour patterns and provide a framework for research and practice to develop team-based workplace solutions. While the literature has been interested in individual productivity in knowledge work, one could also investigate team-level productivity, as well as team-based workplace solutions. Future research needs to emphasise the value and support for team productivity.

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Duelling Dialogue: Pairwise Comparison in Academic Workplace Management and Change

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ABSTRACT

Background and Aim. Having constructive dialogue between users and facilities management in workplace changes is elementary. This study explores the use of a pairwise comparison method in combination with participatory item generation in an academic workplace change. The aim was to identify and prioritise key aspects of the working environment that influence Faculty members' daily experiences and to enhance decision-making for Faculty and Facilities Management.

Methods and Data. The study was conducted among a university Faculty of ~400 people. First, the workplace attributes were defined in 4 workshops and analysed qualitatively. Then the main themes were turned into simple sentences (N=33) describing the main content, excluding repetition. Then, a digital pairwise comparison method was used to make structured comparisons of the attributes through prioritization.

Results. The findings highlight important workplace factors affecting satisfaction, efficiency and attractiveness of the campus environment, including spatial arrangements such as security, indoor environment attributes and opportunities for informal interaction.

Originality. This study demonstrates the value of combining participatory item generation with pairwise comparison as a novel approach to workplace analysis in academic settings.

Practical Implications. The methodology enhances user engagement using transparent prioritisation of workplace attributes providing a structured flexible decision support tool for facilities management. Future research should explore the scalability of this method. The method with transparent prioritisation engages users in workplace changes.

Type of Paper. Full research

KEYWORDS. academic work environment, pairwise comparison, prioritisation, user participation, workplace change

INTRODUCTION

Academic workplace design is undergoing significant transformation due to changes in how faculty work. As in many fields, these changes include the rise of "digital" scholarship, hybrid work arrangements, and pressures to use space more efficiently (Adikesavan & Ramasubramanian, 2023; Gratton, 2021; Hopkins & Bardoel, 2023; Krajččík, Schmidt & Baráth, 2023; Migliore et al., 2024). Academic institutions face unique challenges in office renewal due to diverse stakeholder needs and limited budgets. Faculty, staff, and students require spaces that support teaching, research, and collaboration. At the same time, preferences often conflict (Ellis & Goodyear, 2016). Co-creation is increasingly used to align outcomes with user needs (Sanders & Stappers, 2008). Office renewal requires balancing functionality, aesthetics, and stakeholder preferences to foster collaboration and productivity on the one hand and privacy and concentration, on the other. When viewed through the lens of the fit between the person and the physical workplace, ergonomics, seen in a broad sense, is a central attribute (Appel-Meulenbroek, Le Blanc & de Kort, 2017). In all this, faculty offices carry deep

cultural meaning in academia – they are often seen as status symbols and signs of autonomy, spaces for focused work (Samson, 2013).

Recent trends emphasise flexible, technology-enabled spaces (Harrison & Hutton, 2013). For more than a decade now, activity-based work (ABW) and more open-plan layouts or shared workspaces have been installed in increasing numbers. By tapping into employees' expertise and experience, universities aim at workplace improvements that are both effective and responsible. However, budget constraints and varying stakeholder preferences often hinder renewal projects (Ellis & Goodyear, 2016). The change initiatives can also instill anxiety or resistance among faculty (Samson, 2013). These are dimensions that are of critical importance for Facilities Management (FM) in the whole organisation.

To mitigate the risks in the change process, academic institutions are increasingly applying participatory design (PD) methods (Gregory, 2003) that actively involve the end-users (faculty, support staff, and often also students) in the planning and design process (Sandström, 2020). These approaches emphasise the importance of involving different stakeholders in designing and improving their work environments. To be balanced and effective, managing diverse inputs requires structured methods to prioritise options transparently. Academic offices should support diverse activities, from individual research to collaborative ideation and innovation, as do the learning environments (Temple, 2008).

Ergonomic enhancements in offices (new furniture, adjusted lighting, improved acoustic conditions, etc.) similarly benefit from such an approach. Engaging end-users in co-creation and decision-making not only makes visible their tacit knowledge of work practices but can also build a sense of ownership and contribution that ease transitions in change processes (Nielsen & Randall, 2012).

This paper discusses the recent pressure for change faced by most universities, and how one Faculty applied a digital, easy-to-use pairwise comparison method and tool in stakeholder engagement, value prioritisation, and trade-off analysis to support facilities management and departmental leadership during the work environment change process.

LITERATURE STUDY

Decision-making in organisations often involves complex trade-offs among multiple goals and stakeholders. In academic institutions like universities, as in any type of organisation, planning workplace changes – such as redesigning or refurbishing offices or relocating departments – requires balancing factors like cost, employee well-being, space efficiency, and academic collaboration (Christersson, Heywood & Rothe, 2017; Rolfö, 2018; Weber & Gatersleben, 2021).

Although more explicit today and during the past decade or so, participatory design (PD), with roots in the Scandinavian approach to industrial democracy, was already taking place in the 1970s and 1980s (Gregory, 2003). The tenet was and remains to be that those affected by design decisions should have a say in shaping them. This is ever more relevant in collegial academic cultures, where engaging stakeholders in decision-making is an guiding principle and even a legal requirement in many public projects e.g. in Norway (Lefdal, 2023). Despite these official obligations, research shows that genuine user influence, the users' "say" in the decisions, is not always achieved for instance in educational settings (Taylor, 1993). Nevertheless, the expectation of user participation has been an important driver for more collaborative approaches in workplace and campus development (Sandström, 2020).

In academic institutions, traditional approaches to office development were often top-down – facilities decisions were made by university administrators or architects, with limited input from rank-and-file faculty beyond perhaps senior professors or department chairs (Samson, 2013). More recently, new challenges arise, including costs, changing pedagogies with pressure to re-think university learning and working environments, and for instance the need for interdisciplinary and cross-sectional collaboration, and re-thinking the one office, one user paradigm has become important (Pinder et al., 2009; Wilhoit et al., 2016). There is a shift toward workplaces that spatially promote collaboration.

Higher education institutions are focusing on working together across teams, and in spaces that fit different approaches to work (Harrison & Hutton, 2013).

FM is the organisational and technical backbone, and like other working environments, this applies to the academic workplace. FM aligns space, services and governance with teaching and research. The value-adding management model cycles four steps turning user evidence into criteria and metrics across people, process, place and performance (Van der Voordt et al., 2016). Post-pandemic hybrid work amplifies campus-specific challenges. A recent study across Dutch universities (Schuller et al., 2025) identified three intertwined pressures: real-estate mismatches, staff needs for concentration/privacy, and organisational rules that shape actual use (e.g., booking, etiquette). These map to FM levers such as zoning for quiet, simple booking/wayfinding, and governance of shared assets, being are policy packages rather than one-off design moves. Another complementary synthesis shows that environments combining variety with reliable privacy outperform undifferentiated openness; the key is task-environment fit operationalised via space types, acoustics, storage/anchoring and low-friction access (Indergård & Hansen, 2025).

Evidence from higher education on activity-based working (ABW) shows a recurrent gap between intended concepts and implemented daily practice, although the effects on employee well-being still remains less understood (Appel-Meulenbroek et al., 2020). This is widened when governance, norms and support lag spatial change. FM should pair spatial mixes with onboarding, storage policies and clear space-use etiquette and booking to reduce this gap (Nooij et al., 2023).

To reach design solutions that reflect these aims, universities are increasingly applying participatory methodologies in the workplace changes (Sandström, 2020). These approaches emphasize the importance of involving different stakeholders in designing and improving work environments. Open-plan and ABWs have been introduced to promote collaboration and ideation as well as to support organisational change (Van Marrewijk & Van den Ende, 2018). While ABW has potential efficiency and collaboration benefits, university faculty have varying work patterns – e.g. the need for quiet concentration, confidential meetings such as student supervision, and physical storage for research materials –, and many tend to be sceptical in the face of such spatial changes (Samson, 2013). A strong and structured change process is needed to implement intended changes (Van Marrewijk & Van den Ende, 2018).

Multi-criteria decision-making (MCDM) techniques based on pairwise comparisons have been used in knowledge organisations, as they help structure these complex decisions (Labianca, De Gisi & Notarnicola, 2022). They also allow decision-makers – be it management-level decisions or co-creative processes on a broader scale – to compare options or criteria two at a time, simplifying judgments and quantifying priorities. Research in ergonomics and facilities management has shown that MCDM methods are essential for evaluating workplace design alternatives, as office layouts significantly affect worker performance and health (Eraslan, Güneşli & Khatib, 2020). The suggestion in the present study is that these approaches can be helpful also in academic workplace change, although the literature mostly refers to different organisational contexts. However, MCDM-related approaches have been used for e.g. ranking buildings for strategic focus (AHP), or for ranking campus classroom furniture. For instance, Blachowski and colleagues applied Analytical Hierarchy Process (AHP) methodology to select such facilities among the university with special emphasis on people with disabilities (Blachowski et al., 2022), while Khoshabi and colleagues used MCDM for university classroom furniture compared to anthropometric measures (Khoshabi et al., 2020). Nooij and colleagues (2023) performed a literature review on intended versus implemented workspace and change in higher education; however, the studies did not have an MCDM focus. It seems, thus, that direct MCDM applications have not been much used in ABW/academic office change.

By using pairwise comparison methods, universities can potentially engage diverse stakeholders (administrators, faculty, staff, students) in a structured and efficient evaluation of alternatives, ensuring that important criteria (e.g. comfort, safety or interaction/privacy, just to name some examples) are prioritised systematically.

Collaborative strategies in workplace development emphasise the essential involvement of employees in shaping and enhancing their work environments (Partouche-Sebban, Rezaee Vessal & Bernhard, 2022), including the physical space. Participation during the design process can produce more effective and more widely accepted solutions (Abildgraad et al., 2020). These approaches place the end-users as experts of and active contributors to their own work environments. For the purposes of the present study and its pairwise comparison approach, some benefits and examples of pairwise comparison in decision-making are shown in Table 1.

Table 1 Cases, benefits and examples on pairwise comparison for workplace decision-making (inspired by and adapted from Baranski et al., 2023; Humphry et al., 2023; Kou et al., 2016; Michaelson & Hardin, 2010).

Use case	Benefit	Example in workplace design
Project prioritisation	Objective ranking	Choosing which office upgrades to implement first
Feature selection	Reduces cognitive load	Deciding on new amenities (e.g., group room vs. lounge)
Policy evaluation	Minimises bias	Comparing flexible work policies
Team engagement	Increases buy-in	Involving staff in workspace planning
Data-driven decisions	Transparent outcomes	Justifying design investments

METHODS AND DATA

The original data on needs and wishes related to the work environment were collected during online video conferencing workshops using the digital Flinga platform (flinga.fi) in the autumn of 2023. Flinga is a digital application for community knowledge construction. It provides tools for collaborative ideation, commenting, mind mapping and collages. Flinga was used in workshops at the studied Faculty. Information was collected for the development and multi-use of the Faculty's premises. In the workshop, users were asked three questions: *What makes you proud of the faculty's premises? What strategic/functional goals does the multi-use of the premises promote? What should not happen with the additional multiplicity in the use of the premises?*

Users were able to add thoughts and feedback to digital post-it notes that were written under the questions on the Flinga platform. A total of 96 original feedback notes were received. These were used to form the final 33 statements for the Innoduel tool. The feedback was processed and edited in a researcher design workshop that included three experts: deputy head of the department, a senior expert and a store design manager doing their thesis on the change process at the Faculty. The material was reviewed by this team set for the purpose. Duplicates were removed and the wording of individual responses was adjusted for clarity. This process resulted in the formation of 33 statements (Table 2) that reflected the key perspectives the participants had raised concerning their working environment.

Overlaps and individual comments that did not relate to the themes were removed from the feedback, the clearest and most salient points were confirmed, and finally the spelling of the feedback was edited into statements to be used on the digital Innoduel platform. The tool is a device-independent digital co-creation and participation platform designed to support inclusive decision-making within organisations. It enables stakeholders to contribute and prioritise ideas anonymously through a structured process based on pairwise comparisons. Unlike traditional surveys or brainstorming / ideation / service design sessions, Innoduel presents participants with two options at a time, asking them to select the more relevant or important one according to the defined criteria. The platform aggregates responses into prioritised lists, offering real-time, data-driven insights that are immediately actionable. The approach is grounded in participatory design and decision science,

emphasising transparency, stakeholder involvement, and the surfacing of tacit organisational knowledge.

There is no limit to the number of statements for the Innoduel tool, but practice has shown that a maximum of 20 is a suitable number for not being too time-consuming and producing a relevant set of comparisons. Too many pair comparisons have a negative impact on the response rate and user motivation. Again, not all users completed the pair comparison to the end, especially the response rate for the second question was lower, meaning some respondents stopped the comparison task halfway through. The steps of the process from item generation to first steps in the (re)design process are shown in Figure 1.



Figure 1 Steps in the data collection and analysis procedure. Source: Author's own work

The questions addressed the significance of work environment features and their role in supporting smooth everyday operations. In the new Innoduel survey, respondents were asked to compare two features at a time and choose the one they considered either more significant or more important for day-to-day functionality. The questions were: "Which work environment feature or aspect do you consider more significant?" and "Which work environment feature or aspect do you consider more important for smooth daily operations?" Answering both questions required making 20 pairwise comparisons, and participants were also encouraged to contribute their own suggestions if desired.

The survey was distributed to thirteen groups within the Faculty. All participants took part anonymously in the Innoduel co-development process, where they prioritised previously gathered work environment features and introduced new perspectives. This enriched the understanding of development needs and enabled the creation of group-specific rankings from both a significance and functionality perspective.

The Innoduel platform presented the participants with randomised pairs drawn from the selected 33 statements. Each participant received a unique set of comparisons that had not been predefined. The condensed statements are shown in Table 2 (translated verbatim from Finnish).

Participants could also highlight working environment features that had not been previously considered, allowing for new and insightful knowledge to emerge even in the later stages of the process. At the same time, this ensured that the internal knowledge and reflection within each group supported the development of the work environment. Altogether 138 respondents (ca. 35 %) took part in the final comparison cycle, and they represented all the different "departments" of the faculty.

The comprehensive pairwise comparison data were further analysed in a design team workshop that included the four-member core team of the spatial project: deputy head of premises and facilities, campus architect, designer, and senior specialist. In the workshop, the data were unpacked and structured using design methods. The responses were grouped into three main themes: space, interior design and storage.

Table 2. 33 items from workshops, condensed to avoid repetition

The 33 statements ordered into 3 columns		
There is a designated place for personal items, so they don't need to be carried around all the time	Group rooms are a nice idea, provided the group enables real collaboration	Shared spaces are also aesthetically pleasing and comfortable
Privacy must not be lost	Possibility to encounter other people	Defined rules for shared spaces, e.g. phone use, shared work areas
A secure place for research materials and literature	Defined task-specific working areas	Need for a sense of rhythm and variation during the workday
Not just one type of space – diversity is acknowledged	Sufficient coffee and break areas near workrooms	Silence as a shared goal and action
Easily accessible and quickly found remote teaching spaces	Hybrid tools and technologies are easy to use	Sustainability and practicality are visible in daily choices
Hybrid work: smooth transition between in-person and virtual work and daily balance	Traffic light rules, like in the main Library: green = talking allowed, yellow = whisper, red = silent	Workplace tools support and simplify everyday work
Booking spaces should be easy	The environment supports multi-place working practices in a modern way	Cleanliness and order are hard to ignore
Pleasant acoustic environments help with concentration and discussion	Need for quiet workspaces and fewer overly open spaces	Things can be left in the space without being moved
Encounters as opportunities for generating teaching and research ideas	Spaces available on demand for quick access	A teacher needs a quiet space during work breaks, not for work itself like a researcher
Quiet zones vs. group spaces for discussion – predetermined	Lighting adjustability is important	Fully flexible, free work areas for everyone
Attractive and clear spaces that are a joy to work in	Possibility to work at home or another location when suitable	Possibility to do creative work - shared workshops and spaces that accommodate them

The overall themes that are in the strategic plans of the Faculty were future readiness, sharing and pulling power/attractiveness. The results of this structuring and prioritisation formed the primary foundation for the first steps in designing a new workplace model.

RESULTS

A total of 151 responses (visits to the platform) were recorded, resulting in 2,545 individual pairwise comparisons. The top 5 (*italics*) and bottom 5 results with average for all respondent groups are shown in Table 3.

The additions made by the participants to the dataset are shown in **bold**. The aggregated rankings show a clear emphasis on privacy and secure, personal control over work-related items. The highest-rated features were having a designated place for personal belongings (average 5,2), ensuring that privacy is not lost (7,82), and access to a secure place for research materials and literature (8,2). Variety in space types was also valued (10,67), as was the ability to find remote-teaching spaces easily and quickly during the working day (12). In the present case, having fully flexible, free work areas that accommodate everyone, did not find its way to the top priorities. Some of the additions made by the

participants were ranked as part of the dataset, but the items (using any vacant rooms, finances) were not considered priorities in terms of significance or importance for smoothness.

Table 3 Top and bottom 5 results from the pairwise comparison, all respondents

Feature of the work environment	Average ranking - all
<i>There's a designated place for personal items, so you don't have to carry them around all the time</i>	5,2
<i>Privacy is not lost</i>	7,82
<i>A secure place for research materials and literature</i>	8,2
<i>Not just one type of space – diversity is acknowledged</i>	10,67
<i>Easily accessible and quickly found remote teaching spaces</i>	12
Noise-cancelling headphones and other equipment to make everyday work easier	22,55
Finances are one part of the space equation; it's hard to overlook	23
You are free to use any vacant rooms	24,64
A teacher needs a quiet space during work breaks, not for work itself like a researcher	26,9
Fully flexible, free work areas for everyone	30,27

Features related to the physical appearance or attributes, including acoustics or overall attractiveness, were not top priorities in the present population. Making forced pairwise comparisons is sometimes tricky, and it is possible that the randomised pairs overlooked these kinds of features, albeit the method is widely used and valid for exactly these kinds of comparisons. In the general average, the result is in the end a reflection of the preferences and ranking of the respondents.

For the studied Faculty, it was to be expected that a concern related to books and other written and printed material would be present. At the same time, diversified spaces for different users and preferences were found important. This diversification can bring about the need for designated space for storage, as people expect to have to, and have the ability, to use different kinds of space typologies for different tasks of different parts of the workflow.

In such pairwise comparisons where the items are collected from and/or generated by the participants themselves, it is of interest not to overlook any perspective. In the present case, group work spaces were found a nice idea (and the item was originally generated in one of the workshops) as long as they support true collaboration, i.e. are shared with like-minded users or users who benefit from close physical proximity with their group. Within this study, the case of **group work spaces** exemplifies how participant-generated items can carry *conditions* of value that matter for interpretation. The item originated in workshops and, in the ranking stage, was regarded as a “nice idea” **provided** that such spaces enable *true collaboration*: spaces that are shared by like-minded users or by users who specifically benefit from close physical proximity to their group. This conditional framing indicates that the perceived usefulness of group spaces is **relational** (*who shares with whom*) and **task-dependent** (*does proximity support the work?*), rather than an unqualified endorsement of “group space” as a generic category to be had just for the sake of it.

DISCUSSION

The findings from the studied Faculty highlight some nuanced preferences among respondents regarding their work environment. The top-ranked features centered around practical, use-based needs: privacy, designated place for personal items, and secure storage for research materials. These dimensions seem to relate to how physical and psychological security remain central to academic workspaces (Dong, Li & Hernan, 2024). Privacy, but also proximity with colleagues, were repeatedly

found important in earlier research (Hills & Levy, 2014), and remain preferences for the studied academic faculty.

Interestingly, while diversity in space types and accessible remote teaching spaces ranked high, an overall flexibility, such as fully open workspaces were not among the preferred spatial typologies. This might reflect the fear for open office layouts and the fact that both visual and acoustical privacy is needed in an open plan office space (Ding, 2008). Flexibility might be valued in principle and on paper, yet its practical utility is often limited unless accompanied by more personalisable elements, such as lighting (Despenic et al., 2017). Overall, the present results suggest that secure and purpose-driven spaces can promote flexibility, while calling for a balance between privacy, collaboration, and designated, personal and secure storage space. The low ranking of noise-cancelling equipment and ad hoc room use suggests that while convenience tools are appreciated, they do not replace fundamental space design.

In a study by Barton and Le (2023), the studied faculty at an Australian university were the more satisfied with their work, the greater aesthetically pleasing they found their work environment. The role of the physical appearance should not be overlooked in workplace change: the design of the spaces is the task of the designer(s), and design can suggest and produce solutions unimaginable by the users themselves. For this, FM can make use of strategic and transparent tools such as pairwise comparison.

The research and design implications from the pairwise comparison and the data collection (workshop) activities in general are manifold. On the one hand, the pairwise approach can make it more visible to the staff that their contributions are part of the process from the beginning and that the process is maintained by refining the ranking of preferences. Apart from more transparency through the approach itself, also the item generation and its implication for the actual design solutions can increase user acceptance of the decisions made; having contributed on the several occasions provided and having had the opportunity to rank the potential design solutions and dimensions, the participants can more easily feel like becoming owners of the process. However, the forced-choice design can also lead to oversimplification, as respondents may find it difficult to compare attributes that are qualitatively different. Furthermore, the random pairing of items means that some features may be underrepresented in the aggregated outcomes, even if they matter strongly to certain individuals.

While the results of the pairwise comparison were clear in identifying top priorities such as privacy, designated storage for personal items, and secure spaces for research materials, it is important to note that full consensus was not achieved across all user groups. The differences between groups suggest that, although broad patterns emerged, preferences were also shaped by role-specific needs and expectations. This underlines the challenge for facilities management (FM) in balancing diverse and sometimes competing demands (Van Der Voordt et al., 2016), even when using structured participatory approaches.

Pairwise comparison also makes the decisions more solid: different options are weighed throughout the dataset that forms the backbone for the new developments. Managing the data becomes less frivolous, and condensing the outcome into relatively simple units makes preference listing more feasible and even strategic. It can also be used by FM in their internal discussions related to the and overview between different Faculties, forming a data bank of user preferences that enables comparisons for similarities and differences. If the process is repeated in the whole University, it can also create procedural cohesion. Pairwise comparison tools are useful when organisations must prioritise many options quickly while keeping respondents engaged. Because participants only choose between two items at a time, judgments are simpler and less fatiguing than rating long lists.

Recent studies suggest clear benefits and necessary safeguards. First, pairwise workflows can reduce bias and error in crowdsourced judgments compared with simple majority voting, because repeated small choices help people focus on relative differences and produce more consistent signals for

aggregation (Narimanzadeh et al., 2023). Second, evaluators bring systematic preferences and inconsistencies; if these are ignored, rankings may inherit human bias. Bias-aware modelling and transparent quality controls, such as minimum exposure per item, attention checks, and sensitivity analyses, help correct or at least reveal such effects (Ferrara et al., 2024). Third, open voting pipelines can be manipulated through coordinated or strategic responses. Recent work demonstrates simple attack patterns and recommends safeguards like rate limits, randomised pair scheduling, anomaly detection, and pre-registered decision rules to protect integrity (Johnson, Adams & Byrne, 2024). At their best, pairwise tools can provide credible, easy-to-understand priorities for decision-making when paired with good study design and governance, publishing audit trails alongside the final ranking.

For FM, this case demonstrates both the potential and the boundaries of introducing pairwise comparison into workplace change processes. The approach provides a replicable and transparent prioritisation process that can be scaled to larger organisations or compared across faculties. At the same time, researchers should be cautious not to overstate its outcomes. The method works best as one component in a broader participatory design strategy, complementing other forms of user engagement. Methods such as co-design workshops, scenario planning, or deliberative polling may capture different dimensions of user experience, particularly those that emerge in negotiation and dialogue rather than in binary choices. A balanced conclusion, therefore, is that pairwise comparison is a valuable addition to the FM methodological toolkit, but its findings should be interpreted alongside other engagement strategies to ensure a comprehensive understanding of workplace needs.

An added dimension would be to perform the pairwise comparison in a shared physical space, in a dialogue between colleagues and experts. Through the discussions on the selection of one item over the other, the researchers and the community would gain a deep understanding of the process of ranking, of the stances behind the decisions, and of the pains and gains – the rationale – that results in the ranking decision.

A limitation in the study is its focus: one Faculty at one University. Because the study was framed tightly around a specific change initiative based on the Faculty's space-bound strategy and vision, it is a clearly-defined case study. Replicating the same procedure in other Faculties would most probably result in at least slightly different outcomes. Nonetheless, this study has shown the potential of such an approach in collecting, organising, ranking and eventually using participant-generated data for the academic workplace change process. The differences between groups suggest that, although broad patterns emerged, preferences were also shaped by role-specific needs and expectations. This underlines the challenge for facilities management (FM) in balancing diverse and sometimes competing demands, even when using structured participatory approaches.

Thus, while the study illustrates how pairwise comparison can generate actionable and transparent insights for workplace planning, it also highlights the need for critical comparison with alternative participatory approaches. Methods such as co-design workshops, scenario planning, or deliberative polling may capture different dimensions of user experience, particularly those that emerge in negotiation and dialogue rather than in binary choices. A balanced conclusion, therefore, is that pairwise comparison is a valuable addition to the FM methodological toolkit, but its findings should be interpreted alongside other engagement strategies to ensure a comprehensive understanding of workplace needs.

CONCLUSIONS

The pairwise comparison method(s) not only crunch numbers to support workplace change decisions but also serve as a facilitating tool in the change process itself. They can engage stakeholders in meaningful ways, help clarify what an organisation values most, and provide clarity on trade-offs that must be managed. This approach can optimally lead to decisions that are both analytically sound and more broadly supported.

However, the forced-choice design can also lead to oversimplification, as respondents may find it difficult to compare attributes that are qualitatively different. Furthermore, the random pairing of items means that some features (e.g., aesthetics, acoustic comfort) may be underrepresented in the aggregated outcomes, even if they matter strongly to certain individuals. Future applications would benefit from triangulating pairwise results with complementary tools such as focus groups, surveys with open-ended items, or dialogical workshops to capture more nuanced perspectives.

For FM researchers, this case demonstrates both the potential and the boundaries of introducing pairwise comparison into workplace change processes. The method's relative novelty in FM regarding participatory methods is significant: it provides a replicable and transparent prioritisation process that can be scaled to larger organisations or compared across faculties. At the same time, researchers should be cautious not to overstate its outcomes. The method works best as one component in a broader participatory design strategy, complementing, but not replacing, other forms of user engagement such as ethnographic observation, design thinking workshops, or deliberative dialogue.

From the ranking / preference list, directly actionable steps can be formulated, for instance "There's a designated place for personal items, so you don't have to carry them around all the time" → lockers and cupboards will be located near workstations; "Easily accessible and quickly found remote teaching spaces" → privacy pods, resort spaces for supervision will be designed. Showing what was asked for and what was delivered, remembering the limitations (costs, security etc.), is a good way to communicate the value put on user participation. Also, some design and funding decisions are the responsibility of FM, whereas others are for the Faculty to assess and deliver. Responsibilities and limitations should be discussed in a structured manner.

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AI DECLARATION

Large language models (Perplexity, ChatGPT5) were used for language editing.

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Hybrid Learning Challenges Educational Institutions: Corporate Real Estate Strategies to Address the Opportunities of Digitalisation

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ABSTRACT

Background and Aim. The current postdigital era highlights the importance of ICT as an integral component of physical learning spaces. Accordingly, this study aims to identify key corporate real estate (CRE) strategies for educational institutions implementing hybrid learning from a facility management (FM) perspective.

Methods and Data. The study is based on three case organisations, incorporating 12 semi-structured interviews with top and middle managers from Finnish educational institutions.

Results. The research found eight hybrid learning related CRE strategies. According to these strategies, hybrid learning supports coordinated use of space, offers opportunities for sharing space with stakeholders, enables sustainable utilisation of existing space, diversifies ways of participation, increases the need for campus space in online lecturing as well as studying and provides space for a broad volume of users. Through these interdependent CRE strategies, the operational value of the space can be increased, thus enhancing its future security.

Originality. This exploratory research investigates CRE strategies in hybrid learning environment.

Practical Implications. The study sheds light on the role of physical campuses as home bases for digitalisation. With the shareability of hybrid learning, an educational institution has potential for versatile social impacts beyond internal use.

Type of Paper. Short research

KEYWORDS. corporate real estate strategy, digitalisation, educational institution, hybrid learning

INTRODUCTION

Digitalisation has transformed learning environments into hybrid spaces that blend physical and virtual elements, a shift accelerated by the COVID-19 pandemic (Ninnemann et al., 2020; Poutanen, 2023). However, the move towards digital education has already been in progress as part of broader long-term trends (EY, 2020). This evolution challenges traditional spatial practices but also offers opportunities for user organisation. Simultaneously, shifting workforce and societal demands require continuous skill development which underscores the importance of lifelong learning (Dufva & Rekola, 2023). Moreover, student numbers are generally rising in relation to the space available (FullFabric, 2023). In response, educational institutions can enhance space users' experience (JLL, 2022), as new digital formats, such as videos, can be strategically integrated into physical campus design (Savills, 2024). While staff and students have embraced digital tools, institutional structures often lag in supporting these changes (McKinsey, 2024). Thus, in this postdigital era (Lamb & Carvalho, 2024), where technologies are embedded in everyday life, it is essential to reassess how hybrid learning can enhance the value of physical learning environments.

LITERATURE STUDY

In this study, hybrid learning is defined as a concept that integrates an online component (ICT) with a physical learning space, encompassing both teaching and studying by all users within educational institutions. Rather than viewing hybrid learning solely as a pedagogical method, the study adopts a situational approach (Wheele et al., 2023), focusing on the broader learning environment together with its users. A learning space is understood as a physical or virtual context where learning occurs (Sankari et al., 2018, p. 120), and hybrid learning space refers to environments combining both.

FM enables the functionality of hybrid learning spaces, and value-adding FM interventions can support an institution's core processes (Jensen & Van der Voordt, 2017). The value can be examined through various CRE strategies, of which Lindholm et al. (2006) and Gibler and Lindholm (2012) have identified eight as central for organisations. Similar themes are reflected in Den Heijer's (2011) perspective on campus management in educational institutions, providing a framework for understanding value creation in hybrid learning. Sandström et al. (2022) point out that a common challenge in hybrid learning space is insufficient support, which can hinder the full use of digital technologies. This can limit the potential of these learning environments. That is, users require clear guidance which mainly concerns stakeholders within the educational institution. User organisations must therefore designate responsible individuals or teams for hybrid learning space. In other words, users have an impact on the adoption of spaces (Goodyear, 2020). Based on these findings, this forms the CRE strategy of facilitating contact between groups using campus ICT in education.

Collaboration across diverse stakeholder groups, including external partners, remains critical for campus innovation (Rymarzak et al., 2023). Varied spatial forms of interaction have the potential to further advance knowledge sharing (Jansz et al., 2021). In networked hybrid learning spaces, physical space remains essential, as its qualitative attributes provide the foundation on which virtual environments rely (Raes, 2022). In addition, physical space functions as an enabler to produce online content. Thus, users of these networked spaces may also benefit from this indirectly. Together, these insights draw the strategy of bringing different stakeholders together in innovative ways.

Hybrid learning spaces also promote sustainable space use, enabling multipurpose occupancy around the clock (Ninnemann et al., 2020). They are versatile and can be implemented in a variety of existing physical environments, allowing for progress in a manner that complements rather than disrupts the traditional classroom model; they are positioned to build upon the existing factory-based classroom setting while maintaining its foundational structure (Gil et al., 2022). These perspectives highlight using space resource-wisely.

As ICT plays an increasingly significant role in education, the importance of the experience factor has grown (Beckers & Van der Voordt, 2013), leading educational institutions to design learning spaces that deliver the quality users expect (JLL, 2022). This trend can be addressed, for example, by offering hybrid learning spaces that enable different ways of participating simultaneously, for example via audio or chat as an alternative to physical participation (Lamb & Carvalho, 2024). These approaches lead to designing spaces with options for participation.

Institutions should take advantage of ICT opportunities (Beckers & Van der Voordt, 2013) and provide hybrid learning spaces tailored to evolving needs (Sandström et al., 2022). For example, while ICT integration makes remote work possible, some users may still prefer to work on campus even for activities that could be done remotely. The campus can thus play an important role in self-regulated work as well. It can apply to both lecturers and students. Moreover, different user groups have different needs for physical space. This reflects a strategy of offering spaces for new needs.

With ICT, learning is no longer confined to specific times or places, making every part of the built environment a potential learning space (JLL, 2022). Although increasing student numbers generate pressure for larger lecture halls, ICT developments open opportunities for more efficient, flexible approaches to learning (Lamb & Carvalho, 2024). These developments demonstrate realising user volume and space utilisation.

METHODS AND DATA

This study applies a qualitative research approach to examine how CRE strategies support hybrid learning in educational institutions. Qualitative methods are well-suited for exploring complex, real-life processes, particularly when the topic is under-researched and key variables are not yet defined (Creswell & Creswell, 2018; Tuomi & Sarajärvi, 2018). A multiple-case study design was adopted, focusing on three Finnish educational institutions of different sizes: a specialised educator (Case A), a university of applied sciences (Case B), and a university (Case C). Each institution serves as a case (Yin, 2014). The case organisations were selected from institutions that utilise hybrid learning in their operations.

Semi-structured interviews were conducted with top and middle managers of educational institutions, as managers typically formulate their idea of the space user's needs (Beckers & Van der Voordt, 2013). These interviews enabled flexible exploration of hybrid learning themes using open-ended questions (Tuomi & Sarajärvi, 2018). Participants were selected according to Den Heijer's (2011) campus management model to ensure relevant insights into the implementation of CRE strategy, with four representatives chosen from each case organisation. Data was collected in face-to-face interviews between July and October 2024. The interviews were recorded and transcribed for analysis. The interviews were first analysed using a theory-driven content analysis, applying the CRE categories derived from the literature review. This was followed by a data-driven approach, in which the data were explored inductively to identify emerging themes.

RESULTS

This section presents the combined results of 12 semi-structured interviews conducted in the case educational institutions. The analysis is structured around eight distinct CRE strategies in the context of hybrid learning, including those derived from theory as well as those emerging from the data. Table 1 illustrates these main themes alongside the existing CRE strategies identified by Den Heijer (2011) and includes selected quotations from the interviews to exemplify the findings.

The findings from each case organisation indicate that the successful implementation of hybrid learning spaces relies on having a clearly designated individual or team responsible for their coordination and leadership. In terms of CRE strategy, this represents the role of physical space in enabling core organisational processes: without ownership and guidance, even well-equipped facilities risk remaining underused. Personnel thus become a central resource, not only in supporting the use of ICT, in other words online production, but also in ensuring the purposeful use of space, thereby reinforcing the institution's image. From a CRE perspective, real estate functions as a facilitator of networks and collaboration, extending beyond the boundaries of the institution itself; according to the interviews, each stakeholder adds to the hybrid learning space by sharing either physical or digital space. By making facilities available for external partners' webinars and co-productions, both physical and virtual spaces could strengthen the institution's position as a hub for knowledge sharing and innovation.

Another key finding of interviews concerns the efficient use of existing property resources; institutions often implement hybrid learning solutions by repurposing current facilities and technologies rather than relying on extensive renovations. This reflects a CRE strategy of resource-wise property management, where existing spaces are adapted for multiple uses, such as combining teaching rooms with online production possibilities, thereby improving utilisation rates. Even simple ICT solutions can effectively support the multifunctionality of hybrid learning spaces. Designing spaces that allow different participation further demonstrates the CRE emphasis on user-centered value creation. That is, hybrid learning spaces expand accessibility by combining physical presence with virtual participation. At the same time, the growth of remote learning has created new spatial requirements on campus. Institutions reported the need for facilities where lecturers can deliver online teaching and students can study digital content, even when not engaged in face-to-face classes.

Table 1 Formed CRE strategies with quotations in relation to Den Heijer's (2011) framework

CRE strategy of hybrid learning	Related CRE strategy	Quotation of interviewee
Facilitating contact with groups that use campus ICT in education	supporting culture supporting image	"I would emphasise that we made these [hybrid learning] spaces with the decision that we must have a dedicated person to make it work there. It has been an extremely important investment from the [user organisation's] point of view: it has then enabled this online production, i.e. the support of operations." Case A Interviewee
Bringing different stakeholders together in innovative ways	stimulating innovation stimulating collaboration	"Our educational institution produces videos made by our key partners [...] I would see that as the future; we want to strengthen and facilitate access for these stakeholders so that they can utilise these facilities." Case B Interviewee
Using space resource-wisely	reducing footprint	"The increased amount of remote teaching has remained, and I don't see that it will decrease either, and what that means for the space solution, in terms of classroom equipment, we have removed, or at least are now completely removing, for example, those stationary computers from the IT classrooms, and then we go there with the laptop." Case B Interviewee
Designing space with options for participation	increasing user satisfaction	"All of our shared learning spaces are hybrid- compatible in such a way that we can say that lecture recording is one form of hybrid teaching, so they at least enable that." Case C Interviewee
Offering spaces for new needs	supporting user activities improving quality of space	"In the personnel facilities the lack is now that we have far too little space for holding an online lecture where would be a good camera, lights and background and where could the lecturer comfortably conduct online teaching all day. [...] We would clearly like to see more places like this, because some people like to come to the workplace to work, even if it's online." Case B Interviewee
Realising user volume or space utilisation	increasing flexibility	"It could also bring flexibility in that if the number of participants is now 70 and then our space does not hold seventy. But if you implement a hybrid meeting, where 30 come on site and 40 are remote, then we can use a much smaller space." Case A Interviewee
Emphasising the operational value of asset (NEW)		"[Cost savings] are possible, but that's not really what we're aiming for here. [...] We don't have the idea at any point that it would be savings by students not having to come here, because we really hope that students will come here, and that's why we're adding self-study spaces, students' opportunities to be here. [...] We try to offer as many different spaces for education as possible." Case C Interviewee
Improving the operational stability (NEW)		"This hybrid has created opportunities much stronger than what we had before the pandemic. Even though we had that technology, we didn't utilise it at all at the level we are doing now. [...] I would believe that we have even more potential, which we may not even be able to understand yet, that what we could do." Case C Interviewee

In terms of CRE, this highlights the adaptability of real estate to evolving educational practices and the continuing importance of the physical campus as an anchor point for learning activities. Flexibility in the utilisation of facilities is further aligned with CRE strategic objectives; hybrid learning spaces contribute to balancing peak demand and mitigating underuse. Furthermore, leasing is often preferred to ownership as it increases responsiveness to rapid technological change and shifting trends in digitalisation.

Hybrid learning spaces do not necessarily directly reduce the costs of the property, but nevertheless they are wanted to be implemented. Instead of financial value, these solutions are seen to generate

value in the operations of the user organisation and thus serving as an attractive factor for educational institutions. Finally, the findings indicate that hybrid learning spaces contribute to operational stability by supporting the continuity of educational activities in uncertain circumstances. The ability to shift rapidly between physical and online delivery was seen as strengthening resilience and future readiness and thereby leading cost savings - however, there is still considerable untapped potential seen in hybrid learning environments.

CONCLUSIONS

This study explores how hybrid learning creates added value for user organisations through CRE strategies in educational institutions. Hybrid learning spaces can address prevailing trends in the field, such as space utilisation challenges and the increasing emphasis on experience-oriented learning environments. Since the outbreak of COVID-19, educational institutions have faced growing pressure to add online components to physical learning environments.

The integration of ICT expands participation options, enabling internal and external users to interact in hybrid learning spaces: both physical and digital environments can be shared, allowing institutions to contribute their influence on hybrid learning space. Moreover, these spaces can support online production which demonstrates the many dimensions of sharing. Through these opportunities, it is evident that the role of educational institutions is shifting towards becoming home bases for digital production, functioning in parallel with traditional learning and together shaping the educational environment. Physical space remains a key enabler of hybrid learning, despite the growing use of digital technologies. Overall, hybrid learning spaces provide operational value and security for educational institutions to continue their learning activities even during exceptional times.

This study makes a novel contribution by linking CRE strategies with hybrid learning spaces from FM perspective. In doing so, it extends existing CRE strategy theory (e.g. Lindholm et al., 2006; Gibler & Lindholm, 2012) in the context of campus management (Den Heijer, 2011). However, a limitation of this research is that examined FM decisions, when based solely on management perspectives, may not fully support the understanding of the added value of hybrid learning to the user organisation. Consequently, the development of learning spaces should be informed by space users (Kok et al., 2013). While the findings provide insight, the limited number of cases restricts generalisability. Future research could extend the findings to other countries and institutions to assess the broader applicability of formed CRE strategies. In addition, hybrid learning environments may affect urban development, particularly in university towns and rural areas, offering a compelling direction for future research.

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Disability Inclusion at Dutch Campuses: Responsibilities for Facility Management and Implications for Society

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ABSTRACT

Background and Aim. Facility management (FM) is pivotal in creating spaces and services that foster equitable and cohesive societies. A role that becomes even more critical as one in four adults in the European Union is disabled, with 52% experiencing discrimination (Eurostat, 2025). Despite the EU's 2007 ratification of the United Nations Convention of Rights of Persons with Disabilities (CRPD), local initiatives have yielded disappointing results, causing the "medical model" for disability inclusion to prevail and the anticipated "social model" to await its turn. The aim of this paper is to identify how FM can drive a transformation from the medical to the social model, by applying a hospitality perspective.

Methods and Data. This paper integrates personal viewpoints with literature to identify key challenges. By taking the case of Higher Education (HE) on Dutch campuses as a reflection of a diverse society, the hitherto invisible impact of hospitality on inclusion becomes apparent.

Findings. The discussion on the role of FM within disability inclusion is progressing slowly, as research on the topic remains limited. This paper exemplifies the impact of FM and seeks to inspire FM-professionals to adopt hospitality-driven approaches towards disability inclusion.

Originality. Researching inclusion from a hospitality perspective offers a new perspective on inclusion and enriches FM, strengthening the importance of the field while actively contributing to positive societal change.

Practical Implications. This paper fosters awareness among future facility managers and designers to prioritise and embed inclusion into their practices, giving FM the opportunity to strengthen its field and positively impact society.

Type of Paper. Viewpoint

KEYWORDS. campuses, disability, higher education, hospitality, inclusion

INTRODUCTION

According to UNESCO (2015), the field of education is considered a key entry point to creating more inclusive societies. Failure to provide all children with education is seen as being tantamount to perpetual exclusion, as success in education is linked to success in other areas of life (Jones, 2010). In its evaluation of the Dutch implementation of the CRPD, eight years after its ratification in the Netherlands, the United Nations (UN) expressed several concerns, e.g., in the field of education. This included: (1) the perpetuation of the dual education system in the Netherlands, (2) the high and increasing number of children placed in special education, (3) the limited training provided to teachers in general education, (4) the lack of accessibility in mainstream schools, and (5) reports on the existing stigma against disabled students, including the discouragement towards people with disabilities to access tertiary education (United Nations, 2025). Furthermore, in article 27 of their report, the UN committee expressed a concern about the ongoing use of the medical model to promote the

employment agenda for disabled individuals. The medical model for inclusion entails that disability is the result of an individual's impairment and is therefore an individual problem (Spaan et al., 2024). Conversely, the favourable social model considers disability a socially constructed phenomenon (Retief & Letšosa, 2018). Both models will be discussed in more detail further on. It is important to note that terminology around inclusion is as diverse as the concept itself, and is, for instance, often used interchangeably with the word "accessibility". Henceforth, for the purpose of clarity in this paper we use the word "inclusion", offering a broader scope on mere accessibility, by including a sense of belonging. While focusing our viewpoint on disability inclusion, we recognize that inclusion itself involves other factors of diversity that share an intersectional relationship. We also use the phrase "disabled students", whom we consider to be "experiential experts" in the shift towards the social model, which will be explained further on.

When examining the numbers, we see that one in four European adults is disabled, with 52% experiencing discrimination (Eurostat, 2025). Moreover, the same study also reports that only 29% of disabled individuals obtain a tertiary degree (post-secondary education), compared to 44% of non-disabled people. In the Netherlands, the numbers are even larger, with 32% of its population reporting on disabilities, making the Dutch context an interesting case for this paper. Despite the EU's 2007 ratification of the CRPD and the EU's 2021 adoption of the Strategy for the Rights of Persons with Disabilities 2021-2030, occidental society has yet to become truly inclusive. At the same time, the need for skilled professionals and shortages on the European labour market are becoming more evident (European Union, 2024b) due to an ageing population (European Union, 2024a), whereas simultaneously, increased work pressure can be expected to lead to more people feeling burnt-out (Iribarren, 2025). The urgency to make inclusion an integral part of daily life is pressing, allowing disabled people to live equitable lives and participate in the labour market, while contributing to their country's economic product.

It is time for a new perspective on inclusion, including lateral thinking (Jones, 2010), systematic change (Spaan et al., 2024), and appreciation for the complexity of the disabled student experience (Brewer et al., 2025). The role of FM in this perspective is pivotal, as it is FM that is responsible for a wide range of functionalities in society (Jensen et al., 2012). A reflection of society can often be found in HE campuses (DeVitis et al., 2016), where similar FM responsibilities are present (Jansz et al., 2020; Kok et al., 2011). Furthermore, campus facilities and student success have proven to be interrelated (Brink et al., 2023; Kok et al., 2011). Disability officers often operate from within student services, that are part of the FM department of HE institutes (Ali et al., 2024). The influence of FM is therefore not limited to merely the built environment, design and facilities, but is also focused on services and interactions between students and employees. With education being seen as the key entry point to society, FM can use the case of Dutch HE campuses, to encourage the necessary transition to the social model for disability inclusion. Furthermore, the case can be utilized to reveal the wider societal impact of a hospitality perspective on disability inclusion, and thus the pivotal role of FM. This paper therefore focuses on the case of Dutch HE campuses as an example for the transformative implementation of the hospitality perspective on broader societal inclusion. Reflections on our main concepts, boundary decisions, and exemplification from Dutch cases are combined, while focusing specifically on hospitality within FM and on disabilities within the larger scope of inclusion.

First, to explore the relationship between disability inclusion and hospitality, a definition of disability inclusion seems relevant and necessary, covering several models and related research findings. Second, hospitality is emphasised, with its wider impact on individuals beyond the often-researched areas of food and entertainment. Third, we relate both concepts to the field of HE within the Dutch context, and apply the concept of "Universal Design" (UD), and two hospitality models; the "HOST Model" and the "E³ Hospitality Virtue Scale", by using lived examples of a disabled student's experiences in HE. We expose the role of FM in making a difference and open up the discussion on whether a hospitality perspective towards inclusion could aid the transition from the medical towards the social model for disability inclusion, providing benefits for society as a whole.

EXPLORING (MODELS OF) DISABILITY INCLUSION

Jones (2010) argues that in an inclusive society, everyone is entitled to full participation in all aspects of life, enjoying equal rights and responsibilities. This includes three dimensions of inclusion that must be operational for disabled people to be included; (1) a non-discriminatory attitude towards disabled people; (2) the guarantee of access to participation in every area of life; and (3) the facilitation of disabled people to limit the impact of disability (Jones, 2010).

THE MEDICAL MODEL IN THE DUTCH CONTEXT

In the Netherlands, more than six out of ten citizens have one or more disabilities, including 89% of physical disabilities and 20% in the scope of sensory disabilities (CBS, 2022). The Dutch ratified the CRPD in 2016 and as the Netherlands are a decentralized utilitarian state, policy implementation on inclusion was subsequently entrusted to local governments. Often by means of a so-called "Inclusion Agenda"; a rural activity list concentrating on stimulating participation of disabled citizens, Dutch municipalities have placed inclusion in the hands of their healthcare and societal welfare departments, in line with the medical model for disability inclusion. The medical model assumes that disabilities are a medical phenomenon attributed to an individual and sees disability as an abnormality (Haegele & Hodge, 2016). The model defines disability in a fundamentally negative way (Retief & Letšosa, 2018), and reinforces able-bodied people as the norm, perpetuating stigma and discrimination (Guevara, 2021). In line with Jones (2010) however, we argue that while a medical approach can certainly contribute to improved physical abilities on an individual level, the approach cannot provide for the right of equal citizenship and social solidarity.

The Need for a New Perspective

Many rights and laws have been adopted ensuring the equal participation of disabled citizens (see also Spaan et al. (2024) on "Legislation and Historical context", p.8). In 2023, the Dutch even added disabilities to their non-discrimination grounds defined in the fundamental rights of their constitution. However, five years prior to the deadline of the UN Sustainable Development Goals (UNSDG), in which the position of disabled persons in HE is protected and participation is encouraged, we are simply not there yet. Terminology emphasising the medical model for inclusion, segregation of disabled pupils in primary schools, the need for disclosure of student disability, and a neoliberal shift in HE policy (Shaw, 2024; Spaan et al., 2024), have ensured the maintenance of the medical model for inclusion in HE, that risks the reproduction of hierarchy and ableism and ignores both privilege, power, and student experiences (Shaw, 2024). Furthermore, stigma, disclosure, and the role of non-disabled students must also be regarded as important components of inclusive HE (Shaw, 2024); this coincides with the first dimension of disability inclusion as provided by Jones (2010). Following their analysis from 60 online forum posts on disability inclusion in HE, Brewer et al. (2025) derived six relevant themes from disabled HE students' experiences, being: (1) impact on education, (2) isolation from peers, (3) seeking advice and support, (4) barriers to assistance and accommodations, (5) impact of accommodations, and (6) providing guidance and support. From their analysis, they concluded that disabled students remain systematically disadvantaged compared to their non-disabled peers. It is time for a new perspective, one which FM can offer with hospitality.

A Shift to the Social Model

In contrast to the medical model, the social model assumes that disabilities are a societal construct that imposes disabilities on people with impairments (Guevara, 2021), considering disability a socially constructed phenomenon (Retief & Letšosa, 2018). Using the right terminology is important for the adoption of the social model, as words affect the way we feel about certain concepts and aid in creating or removing stigma (Shaw, 2024). Whereas "impairment" refers to a loss or abnormality in bodily and/or mental functions and/or structures, the term "disability" indicates a restriction or lack of ability, resulting from that impairment (Guevara, 2021; United Nations, 2003). Definitions of both the terms "disability" and "impairments" may however vary across governmental- and HE institutions, as do their policies and practices (Spaan et al., 2024). The latter complexifies the adoption of the social model even further. This can be seen on both small and large scales, such as by Eurostat who, in their

data collection on disabilities, describe disability as a “limitation in usual activities due to health problems” defining disability as “activity limitation” (Eurostat, 2025), stressing the medical model for inclusion and leaving out the view that it is society limiting and defining the “usual activity”, not the impairment or individual itself. For the purpose of this paper, the phrase “disabled students” is used. This refers to students who experience restrictions, resulting from the inadaptability of society to accommodate their impairments.

Within the social model, instead of focusing on retrofit in the built environment, and making adjustments to accommodate people with specific impairments, its design would be universal and therewith more optimal for all of its users, with or without impairments. This also relates to the concept of UD, which we will discuss in more detail further on. The social model embraces universalism and maximises individuals’ potential, because the attitude towards people with disabilities would be different (Guevara, 2021), creating a difference in interactions, and services as well.

EXPLORING (MODELS OF) HOSPITALITY

Hospitality is an important part of FM and is not limited to tangible aspects (Groen et al., 2014). Line et al. (2025) contend that both Aristotle and Plato identified hospitality as a fundamental part of human condition. They also suggest that hospitality has been studied as either (1) a value, (2) a context, (3) an organisational culture, or (4) as a means to create memorable customer experiences (Line et al., 2025). Many researchers have debated the concept of hospitality and most of them refer to the second and fourth category mentioned above. In this context, a literature review of King (1995) showed characteristics of hospitality in its “modern sense”, relating these to the food and beverage industry. These findings were consistent with Brotherton (1999). Hepple et al. (1990) defined four characteristics of hospitality, being: (1) it is given by a host to a guest who is away from home, (2) it is interactive, (3) it concerns both tangible and intangible factors, and (4) it entails a provision of security and comfort which is provided by the host (Brotherton, 1999; King, 1995). Lashley (2000), however, called for a more enriched understanding of the concept and proposed a three-way division in which private, commercial, and social domains of hospitality were defined.

A Focus on Built Environment, Services and Interactions

What the above-mentioned definitions have in common, is that both tangible and intangible characteristics need to be taken into consideration, and that there is always an interactive relation between “host” and “guest”. Following these definitions and our case of Dutch HE campuses, hospitality may have a focus on two areas; (1) the built environment with its design and facilities, including both tangible and intangible factors (hereafter referred to as: “BE”), and (2) the services and human interactions, in our case between staff and students (hereafter: “SI”).

The Impact of Hospitality on Disability Inclusion

Above, it is shown that only a few scholars discussed the vast potential of hospitality with an impact on societal change. To our knowledge, none of them have suggested or researched the impact of hospitality on disability inclusion specifically. According to Ogunyemi et al. (2022), caring for others has, however, been at the heart of hospitality throughout human history. When private hospitality transitioned into its current commercialized form, both host and guest became depersonalized, endangering hospitality in the public sphere with a loss of the virtues previously connected to private hospitality, such as charity, generosity, and justice (Ogunyemi et al., 2022). This transformed the field of hospitality into an industry and context, abandoning the virtue that was associated with private hospitality. Because of its connection to both BE and SI, FM holds the power to truly and positively integrate disability inclusion using a hospitality perspective, impacting not only our own industry, but society as a whole. Bringing back the virtue of hospitality, will allow a transition from the medical to the social model for disability inclusion and might just be exactly what societies need, for disability inclusion to become an integral part of life. What if we would take inclusion away from the governmental domains frequently designated for inclusion, and embrace it as a responsibility of FM?

Opening up a mindset that hospitality can impact inclusion was already prevalent in the writings by the French philosopher Levinas (1905-1955) who stated that hospitality involves acknowledging the humanity of “the other”, “recognising their infinite value”, and arguing that “humanity’s ethical responsibility towards that other precedes any conceptual understanding or social contract” (Line et al., 2025). Line et al. (2025) also mention Conway (2014), referring to cautious exploration of a cross-over to inclusion, by noting that hospitality enables people to open themselves to others, so that both parties can discover commonalities between them and begin exploring what is richly diverse. With an increasingly diverse population, the need for a more customised experience is growing. The adoption of a hospitality perspective towards inclusion, seems rational for organisations, especially in the current context of a declining and ageing workforce with a latent sensitivity to burn-outs, as described earlier.

APPLYING HOSPITALITY MODELS TO INCLUSION

Whereas UD has an obvious and already available scholarship in BE; a large part of FM’s responsibilities, two hospitality models, being the “HOST Model” and the “E³ Hospitality Virtue Scale”, can be used to improve inclusion in SI. Applying all three concepts, allows us to discover hospitality’s ability to affect inclusion in (1) BE as well as in (2) SI, that both contribute to the three dimensions of inclusion as mentioned by Jones (2010). In the following sections we will discuss UD and the two hospitality models and exemplify their impact on the transition from the medical model to the social model for disability inclusion. First, we will explain all three concepts and their impact on BE and SI.

The Concept of UD in BE

The term of UD was first coined in 1997 to reflect on the approach in which a broader and more diverse audience is taken into account in design, minimising the need for adjustments and creating a more functional product to a broader range of people (Mcguire et al., 2006). It includes seven design principles that challenge disabling values and attitudes of society; (1) equitable use, promoting a design useful to people with diverse abilities, (2) flexibility in use, accommodating for a wide range of individual abilities and preferences, (3) simple and intuitive use that is easily understandable for everyone, (4) perceptible information, where the design communicates necessary information effectively to all users, (5) tolerance for error, where hazards or adverse consequences are minimised, (6) low physical effort for efficient and comfortable use by all, and (7) size and space for approach and use, that are appropriate for users with diverse abilities (Uyaroğlu, 2017). Implementation of UD in HE campuses appears to be promising and can provide a starting point for universities and disabled students to meet, and formulate a more inclusive learning experience (Fleet & Kondrashov, 2019). UD mainly focuses on BE and coincides with the hospitality perspective in that it considers the relational aspects of disability involving person, interaction, and barriers (Lid, 2014).

THE HOST MODEL IN SI

Bilgihan et al. (2024) offered the “hospitality-oriented society of tomorrow framework”, called the “HOST Model”, with which they suggest a reconceptualised approach towards the concept of hospitality, in order to unlock its full potential for transformative societal change. The authors mention three conceptual pathways of hospitality, being: (1) application; converging on context and industry, (2) infusion; through talent, research and practice, and (3) transformation; viewing hospitality as a change catalyst by returning to its fundamental virtues (Bilgihan et al., 2024). Their model also includes a reciprocal relationship with the five pillars of the UNSDG 2030 agenda, being: people, planet, prosperity, peace, and partnership, stating that hospitality both impacts and is simultaneously impacted by these five pillars (Bilgihan et al., 2024). According to the authors, research in hospitality often merely concerns the one-way impact of the context in which hospitality is researched, whereas their HOST Model points towards a more holistic understanding of the role of hospitality in society. For each of the five pillars, their reciprocal influence on hospitality was examined (see also Bilgihan et al. (2024) on “the pillars of societal progress: 5P’s of sustainable development”, p.2263-2268).

The E³ Hospitality Virtue Scale in SI

Another model focusing on the virtue of hospitality, the “E³ Hospitality Virtue Scale”, was introduced by several of the same authors, and can be considered a deepening of the HOST Model’s infusion pathway, including three descriptors to operationalise hospitality as a virtue in individuals offering hospitality, being: (1) empathy, (2) execution, and (3) embrace (Line et al., 2025). These descriptors determine character interventions that enhance the frequency and magnitude of the hospitality virtue in individuals in society and see hospitality as an individual personality trait. The authors further describe hospitality as an action-based concept, involving the regular practice of caring for others, especially strangers, in one’s daily life. They also suggest that the practice of hospitality at an individual level, can have a significant effect on a broad variety of perceptions and behaviours (Line et al., 2025).

Table 1 Disabled students’ lived experiences in Dutch HE, categorized into six themes

Related and summarised examples from the case study of “Tess”, as described by Spaan et al. (2024)	Themes defined by Brewer et al. (2025)	Explanations as described by Brewer et al. (2025)	Affected Areas of Hospitality	
			BE	SI
Example 1: “Getting a laptop” The disability office required Tess to provide medical proof that she had trouble writing, a few weeks before every exam, so that she could use a laptop during examination.	Impact on Education	Additional effort is put in by disabled students, spending extra time, energy, and funding to make relevant arrangements for accommodations that allow them to equally participate in HE.	V	
	Barriers to Assistance and Accommodations	Students are asked to disclose their disability and provide proof, both emphasising a hierarchy in interactions between disabled and non-disabled persons, because of existing barriers in the built environment, design, and facilities.	V	V
Example 2: “Introduction week” Tess participated in an introduction week for students, organised by student organisations and HE institutions, to get to know other students and the town. She disclosed the scope of her disabilities in advance and was told participation was possible. However, the week included a great deal of walking and visiting a building with many stairs. Both were considered a “normal activity”, excluding Tess from participation with peers. It is likely that other disabled students were also affected, but there was no structure to make interaction with them possible.	Isolation from Peers	Social support for disabled students, offered by non-disabled peers can substantially support student well-being, retention and performance, yet non-disabled students may fail to understand a condition or display discriminatory attitudes and behaviour.		V
	Providing Guidance and Support	The importance for disabled students to share their experiences through online/offline engagement with other disabled students, contributing to a sense of community, well-being, and social support.		V
	Seeking Advice and Support	Disabled students need emotional and practical support, in navigating the possibilities for access to campus facilities, preferably by their peers. Disability support services are often not visible and options for additional facilities unknown.	V	V
Example 3: “Open-day orientation” In her search on finding an interesting study, Tess visited an open-day of a HE institution and was immediately referred to the disability office for a one-sided conversation on what she could and couldn’t do. The disability office explained to her the stretch of her abilities without considering her actual options and personal opinion. They suggested playing an instrument with her feet instead of her hands, assuming that she couldn’t play with her hands, to which Tess responded that she doesn’t have feet.	Impact of Accommodations	Limited and/or unsupportive disability services. Accommodations frequently have their limitations that need to be known to disability officers, which is often not the case.	V	V

BE = Built Environment, Design & Facilities, SI = Services & Interactions

Applying Hospitality Models to FM Practice in HE

Dutch research in 2024 shared experiences from a disabled student referred to by the pseudonym of “Tess” on disabilities and HE (Spaan et al., 2024). In Table 1, three empirical examples mentioned in this latter publication, are categorized into the previously mentioned themes of Brewer et al. (2025). Affected areas of hospitality are indicated to show the impact of the described examples for FM practices.

What is remarkable is that all examples of students’ lived experiences mentioned in Spaan et al. (2024) and Brewer et al. (2025), find their origin in the medical model of disability inclusion, as they are concentrated on the fact that disability is viewed as an individual, medical condition. As table 1 shows, when reviewing these examples from a hospitality perspective, a relationship with both elements of hospitality and therefore FM, can clearly be seen in all three examples. Table 2 shows an overview of the examples mentioned, including their transformation when approached from a hospitality perspective, implementing the concept of UD for the affected areas of BE, and the HOST model and/or E³ Hospitality Virtue Scale to the areas of SI.

Table 2 Applying a hospitality perspective to inclusion

Examples from the Medical Model for Disability Inclusion	Transformation to the Social Model for Disability Inclusion	
	<i>Implementing the UD principle to BE</i>	<i>Implementing the HOST Model and/or the E³ Hospitality Virtue Scale to SI</i>
Example 1: “Getting a laptop”	Designing accommodations for universal, instead of generic users, creates facilities and places that suit both people with and without disabilities, without focusing on retrofit. By creating universal opportunities for examination, FM can create equity in design, preventing disclosure of disabilities that affect the hierarchy in relationships and saves the extra time spent by students with disabilities allowing equal participation, time better spend on academic results and development.	Hospitality training can improve the hospitality virtue in HE staff, creating improved services and interactions and making the extra time and energy spent on comprehensive individual arrangements obsolete.
Example 2: “Introduction week”	If HE buildings and other on-campus and off-campus infrastructures would be universally designed, disclosure of disability would not have been necessary and the student from the example could have fully participated because her impairments were not turned into a disability by shortcomings in the physical environment surrounding the student.	Considerations on what is perceived as “normal” are changed from within a hospitality perspective. A hospitality mind-set of non-disabled peers can create more meaningful interactions between disabled and non-disabled students.
Example 3: “Open-day orientation”	Implementing UD in BE can take away the need for specific accommodations required to facilitate students with disabilities, making HE institutions and other on- and off-campus locations inclusive for all.	Improved empathy and knowledge from HE staff can aid disability services and assist in acquiring the right facilities for an inclusive environment.

In the first example, we see that available facilities were not universal and therefore inadequate to provide equity in education, which UD could have prevented. Next to that, a service was provided, yet the interaction between staff and student created a hierarchy between the non-disabled and the disabled, as disclosure and proof of disability were requested. A lack of the hospitality virtue in campus staff and a need for training can be identified, in line within the infusion pathway of the HOST Model relating to the E³ Hospitality Virtue Scale, from which the three E’s are needed in staff to view students as persons instead of numbers, taking a step back from standardised checklists and focusing on justification instead, to ensure equitable participation. Preferring a hospitable attitude over bureaucracy will allow for a different dialogue and loss of hierarchy based on disability. By applying UD to the second example, equitable participation would not have been hindered by BE, because the infrastructure, and with it the perception of what constitutes “a standard environment”, would have been altered. Consequently, applying the HOST Model’s pathway related to transformation in the second example, hospitality could provide a catalyst role in the way we perceive each other, and what is considered a “normal ability”. Also, here we see the importance of the E³ Hospitality Virtue Scale,

this time related to the non-disabled peers. Applying a hospitality perspective to the third example shows equitable participation in education through UD and simultaneously reveals a lack of empathy from HE staff and a lack of knowledge and understanding of facilities, needed to provide an inclusive environment. As can be seen from table 2, solutions provided by applying a hospitality perspective to the student's lived experiences, transfers their origin from the medical model to the social model for disability inclusion, contributing to; (1) a non-discriminatory attitude towards disabled people; (2) the guarantee of access to participation in every area of life; and (3) the facilitation of disabled people to limit the impact of disability (Jones, 2010).

DISCUSSION

As this paper pointed out, disability inclusion has not yet reached its full potential in the Netherlands, where the medical model prevails and transformation towards the social model, although anticipated, still awaits its turn. Seeing as education is an important entry point for participation in society, and because of a campus' resemblance with functions in broader society, the case from Dutch HE campuses was taken to exemplify the role of FM in disability inclusion. As table 1 shows, the hospitality perspective exposes the influence of FM on disability inclusion with a direct impact for disabled students in Dutch HE. Barriers in BE and SI can either be resolved or prevented by inclusive FM. UD was used in the transformation of BE, and the Host Model and E³ Hospitality Virtue Scale were implemented for transformation in SI (table 2). This resulted in a hospitality perspective that can be used to ease and accelerate the transition from the medical to the social model for disability inclusion.

The shift from the medical to the social model has been a favourable point of view in many studies that contest the medical model and put forward the social model. It should be noted, however, that the social model also comes with its limitations. As Lid (2014) mentioned for example, the social model itself can hinder the implementation of UD, because the model overlooks the complexity of disabilities as human conditions, making the critical role for experiential experts (disabled students that share their experiences, using professional skills to do so) underexposed. Furthermore, it is also important to note that inclusive design focuses on more than merely accessibility, as such a focus can hinder actual inclusion (Spaan et al., 2024). Therefore, distinguishing accessibility from inclusion and continuing to include disabled students as experiential experts, remains important for future research. Inclusion extends beyond accessibility; it encompasses being recognised as part of a community and participating on equal terms, in order to genuinely "feel welcome", in education but also in all other areas of life. The impact of FM on disability inclusion should therefore not be overlooked, as hospitality's main aim is to instil this feeling from the outset. The hospitality perspective described in this paper simultaneously strengthens the field of FM and positions hospitality as a social science, bringing back the hospitality virtue and viewing hospitality as a separate research field, rather than primarily an industry or context. Practical implications of this perspective are therefore significant and impact broader society, outside the reflective scope of Dutch HE campuses.

Viewing hospitality as a catalyst in the transformation from non-inclusive to inclusive societies, offers a new perspective on the position of disabled people, but also on inclusion in a wider sense. The hospitality perspective therefore does not only limit itself to disabilities, yet offers opportunities for other diversity factors, that society has yet failed to make her own. Intersectionality of these diversity factors should be part of further research, to account for its complexity in diversity issues (Spaan et al., 2024). Furthermore, this paper offered a hospitality perspective on inclusion by suggesting UD, the HOST Model and the refinement thereof by means of the E³ Hospitality Virtue Scale; the relevance of other hospitality models needs to be explored in order to further develop the hospitality perspective on disability inclusion and create a new conceptual model for implementation. Other models concerning disability inclusion, such as the moral and/or religious model, the identity model, the human rights model, the cultural model, the economic model, the charity model, and the limits model may also be relevant in this context (Retief & Letšosa, 2018).

CONCLUSIONS

Focusing on hospitality can create a paradigm shift for disability inclusion and the adoption of the social model, as the hospitality perspective on inclusion changes the way disability is viewed in society. Rather than seeing “people with disabilities”, focusing on individual medical issues, hospitality with its focus on BE and SI, allows us to consider “disabled people” instead, focusing on barriers created by society and on what society can do to alleviate, remove, or even better, prevent them. By applying a hospitality perspective, FM can take away barriers for disabled students to equally participate in education. This will aid disabled students in becoming self-sufficient and contributing citizens, providing solutions for the declining availability of skilled talent on the labour market. Our explorative application of hospitality models to disability inclusion at Dutch campuses, showed that such an approach can change the way disabled (and non-disabled) students perceive their campus and community, causing a smoother entry into broader society as participating citizens. The field of HE can serve exemplary for other areas in society where inclusion is still on the waiting list. More research of students’ lived experiences is necessary, as their experiential knowledge provides an invaluable contribution and should not be overlooked when using the social model for disability inclusion. Future research should therefore concentrate on creating a conceptual model for a hospitality perspective on inclusion that brings back the virtue of hospitality and incorporates UD, without negating the valuable influence of experiential experts. This will allow for application beyond disability inclusion and the scope of HE, and for inclusive FM to truly transform societies.

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A Meaningful and Vibrant Work Environment

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ABSTRACT

Background and Aim. Research highlights that poor workspace variety, poor zoning, and limited personalization can reduce comfort, privacy, and focus in hybrid environments. This study aims to anticipate these challenges and to develop and evaluate participatory design interventions for user-centered, efficient workplaces.

Methods and Data. This study adopted qualitative techniques and was structured around a case study at an office in the Netherlands. The work environment was studied through needs assessments with interviews. Design interventions were subsequently explored in participatory focus groups, utilizing 3D scale models and 2D visualizations to facilitate collaborative input. Finally, these interventions were evaluated with end-users to determine their effectiveness in enhancing the hybrid work environment, focusing on comfort, functionality, and engagement.

Results. The study revealed a lack in workplace diversity which compromised comfort and privacy. Additionally, the absence of clear zoning disrupted focused work and reduced workplace efficiency. There was also a lack of elements that foster personalization, identity, and positive experience, making the work environment less inviting and less inspiring for employees.

Originality. By presenting solutions in direct interaction with users, valuable insights for facility management (FM) were gained into the supposed effectiveness of interventions in office design, organizational needs, and individual preferences.

Practical Implications. The use of 3D scale models and 2D visualizations can help FM to enhance the integration of organizational needs and user experiences, while simultaneously fostering employee engagement and a sense of ownership.

Type of Paper. Short research

KEYWORDS. design research, healthy workplace, hybrid work environment, office design, participatory research.

INTRODUCTION

The rise of hybrid working, was accelerated by the COVID-19 pandemic. Hybrid working can be explained as a work arrangement that offers flexibility in terms of when and where the work is performed (Bergefurt et al., 2024). Where office work was the norm previously, many organisations have now embraced a hybrid model that offers benefits such as increased flexibility and better work-life balance (Mobach, 2023), but also new challenges such as a frustrated work process and declining well-being regarding the physical working environment (Forooraghi et al, 2020), the desired degree of flexibility (Handler, 1970) to allow alternation between home and office work and the adequate facilitation of activity-related work (Van der Voordt, 2004). Studies confirm that the design of the physical working environment is not merely supportive, but actively contributes to employee well-being, engagement and performance, (Colenberg et al., 2020), and thus to the success of the organisation as a whole (Bergefurt et al., 2024). This case study aims to investigate the extent to which the design of the current office work environment meets the needs that have emerged after COVID-

19, and which user-centred spatial interventions can support facility management (FM) to enhance return to office and employee engagement. The central research question is: “How can (hybrid) office redesign contribute to a meaningful and vibrant work environment?” The study seeks to inform facility managers, workplace managers, and interior designers by reflecting on a re-design process of an office in the context of hybrid work environments.

LITERATURE STUDY

Recent studies underline that effective workplace design goes beyond the mere optimisation of physical conditions. Psychological needs and functional work requirements must also be considered (Budie et al., 2018). Common outcome measures are employee satisfaction, feelings of ownership and belonging, and productivity, linked through the concept of (functional) comfort. When comfort, functionality, and engagement are considered as coherent design principles, a work environment may emerge with the capacity to support both wellbeing and performance more sustainably. Comfort is a layered concept with physical, functional, and psychological dimensions (Vischer, 2008) and is thus more than the absence of discomfort; it makes a positive contribution to well-being and productivity. Functionality refers to the extent to which spatial and technological facilities are adapted to different work activities (Vischer, 2008). In this context, Colenberg et al. (2021) emphasise the importance of flexibility, activity-based design, and autonomy. Moreover, Hoendervanger (2021) highlights the importance of choice and a clear spatial logic. He argues that engagement increases when employees feel psychologically connected to their work environment, which can result from active participation in design or research. This involvement increases the sense of control and ownership, factors that are more reliable indicators of environmental quality than satisfaction or task performance (Vischer, 2008). This study continues the FM tradition of exploring the space–organisation relationship (i.a. Becker, 1981; Mobach et al., 2014), while addressing contemporary developments (Vartiainen & Vanharanta, 2024).

METHODS AND DATA

This study adopted qualitative techniques and was structured around a case study at an office in the Netherlands. The diagnosis of the current work environment was studied through use and needs assessments with interviews. Design interventions were explored in participatory focus groups by utilizing 3D scale models and 2D visualizations intended to facilitate collaborative input. Next, these interventions were evaluated with end-users to determine their effectiveness in enhancing the hybrid work environment, focusing on aspects such as comfort, functionality, and engagement. The study had an iterative character according to the process model of design-oriented research (Turnhout & Andriessen, 2023) and followed the guidelines of qualitative research by COREQ (Tong et al., 2007) for transparency.

Diagnosis

To understand how employees use the hybrid work environment and their needs, qualitative data were collected in the workplace. Two senior researchers conducted 15-20-minute semi-structured interviews at the coffee machine in one day. In preparation, forms were placed at workstations for employees to describe, through text and drawings, how they use their work environment (at home and in the office), their needs for individual and team tasks, and their ideal future work environment. Sixteen employees submitted these self-reports, of which 11 were also interviewed. This combined approach provided rich insights into employee perceptions, needs, and engagement.

Exploration of design interventions

To determine the design interventions two focus groups were formed. Participants were approached directly via e-mail and selected based on team composition and variation in job types to ensure a wide range of perspectives. Two researchers facilitated two focus groups, each comprising six employees, who participated in semi-structured discussions to explore perspectives and evaluate design interventions with a 3D model (Figure 1). The 3D model shows the existing and desired workplaces.

Variations on the current layout - such as more (online) short-stay consultation areas, additional individual workstations and an alternative main route - were integrated directly into the model, making possible adjustments tangible and negotiable. Initially, group questions were reflected and answered individually and then discussed in the group. The group dynamics encouraged participants to clarify and further explore individual and shared perspectives. The sharing of stories and practical experiences contributed to a deepened understanding of personal, shared, and organisation-wide needs. At the same time, participants discussed which spatial interventions were considered most relevant.



Figure 1 3D visualisations of the office (scale model) and 2D visualisations (moodboard session). Source: Authors' own work

To complement the participatory sessions, all employees present in the office were invited to evaluate nine mood boards with stickers. They could indicate what they found appealing with 3 green stickers and what they found less appealing with 3 red stickers (Figure 1). The session was facilitated informally near the coffee machine, creating a low threshold for participation; this was guided by a researcher. This visual and approachable method offered employees a direct and accessible way to express their preferences and strengthened their involvement in the design process. The input from both the focus groups and the mood board evaluation contributes to a richer understanding of shared values, needs and visions within the work environment.

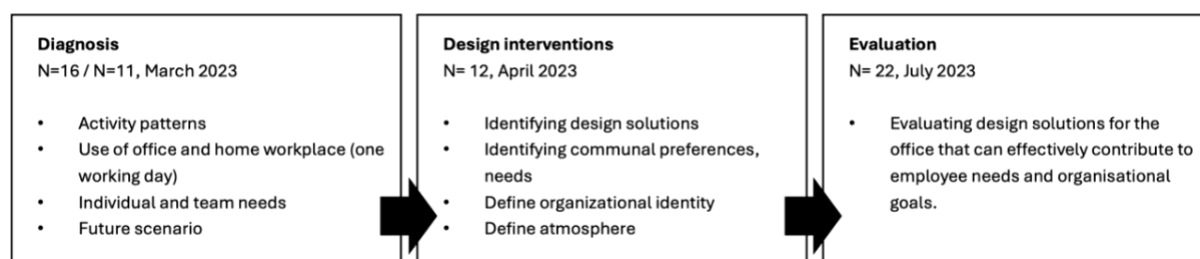


Figure 2 The steps in the research. Source: Authors' own work

RESULTS

Diagnosis

Employees perform individual desk work both in the office and at home. At home, they reported to mainly do focus work and online consultation, while the office is reportedly mainly used for low-concentration work, collaboration, (hybrid) consultation, 1-to-1 (online) calling, knowledge sharing, and brainstorming sessions. Movement in the office occurs when switching between individual work and communication activities, when having lunch in the canteen, or getting coffee. The current outdoor office environment does not invite people to go outside. At home, the environment provides 'natural' breaks more often, such as lunch with the family, short household tasks or exercise outside the home (shopping, walking, children). In the office, employees book a workstation close to colleagues within a semi-open desk configuration (3-4 workstations) and use this as an 'anchor spot' during the day. For

consultations or calls, they use collaboration workplaces. At home, they use either a fixed workstation or alternate between spaces such as kitchen, dedicated office, living room, and attic. This switching is mostly based on practical reasons (e.g., sunlight, occupancy), reportedly less work activity related. For the office environment, there is a need for ergonomic workstations (monitor, sit-stand desk), a need for more and soundproof (online) consultation spaces (1-person, 2-6 persons), where privacy is guaranteed. The current working environment is semi-open with some enclosed spaces. Employees prefer individual control when it comes to privacy (such as being able to open or close doors), indoor climate, and sunlight. The spaciousness, daylight, and sightlines of the current environment are highly valued. Glass is mentioned as a means of combining physical separation with openness.

Design interventions

The reported top 4 organisational core values were: collaboration, openness, commitment and collegiality. For the focus groups questions were asked starting with *“When the organization values are about collaboration, openness, commitment and collegiality, this intervention offers optimisation because...”* Using the 3D model, design interventions for the office concerning improved functionality, comfort, and engagement were discussed. These solutions take into account the core values and requirements of the (organization's) primary service and the hybrid-working landscape and serve as guidelines for the redesign of the work environment. The design interventions that were tested and discussed dealt with **routing** (stimulating physical health, finding colleagues), **zoning** (offering space and comfort for concentration and communication work), **variation** (offering choice in work environment, workstations, privacy and atmosphere), **aesthetics** (organization identity, greenery, art, and colour), **individual control** (control of climate and visual comfort, control over privacy). Participants expressed a lack of clear zoning in the working environment, especially in the demarcation between silence and communication areas. They also highlighted the importance of a logical circulation to find colleagues easily. Regarding workplace diversity, participants reported particular interest in solutions for communication activities with effective sound isolation, such as spaces for small consultations (2-4 people), brainstorming sessions (improving team performance, sharing knowledge), and individual spaces for online communication. There is also a desire for restoration options (with good coffee) after stressful tasks, and more open workplaces for low-focused work as the organisation grows rapidly. Variation in spatially induced atmosphere is being valued as supportive for task activity fulfilling employees' needs. Employees name environmental control and personalisation. Environmental control refers to the functional and physical control that employees have over environmental conditions, such as individual influence of climate comfort (e.g., temperature, light and fresh air) and of privacy regulation (e.g., flexible partitions or signals indicating that someone does not want to be disturbed). Ergonomics also played a role, with height-adjustable workstations such as sit-stand desks providing physical support. Personalisation related more to the visual and symbolic interpretation of the space, offering opportunities to employees that allow them to identify with both the workplace and the organisation. Mentioned were adding colour, art, and plants, as well as visualising the organisational identity, for example, by presenting outcomes of applied research on innovation and sustainability.

DISCUSSION

By examining the office and the home-office environment in a case study, a deeper insight was gained into the spatial conditions that support work processes and employee well-being. The results show that the openness of the office environment can help FM to create informal interaction and knowledge sharing in the organisation. At the same time, employees experience a lack of control over their need for privacy, which is seen as a major bottleneck. This aligns with previous studies (Colenberg et al., 2020; Vischer, 2008). Moreover, the limited sample size (N=5) of the home-office respondents offered valuable insights in the context of discovery and exploration: employees especially value the opportunity to work autonomously ('I can work as I want') and communicate freely at home. This suggests that home workplaces offer employees more control and flexibility, factors that appear to be crucial for job satisfaction and well-being. The extent to which a working environment supports

concentration work, collaboration, and recovery is found to be a determining factor in employees' choice of location. Although the office matches the organisational identity in terms of openness and light, the findings show that additional spatial conditions are needed, such as spaces for (online) consultation, silence areas, and spaces for concentration work. In addition, employees miss inspiring elements such as greenery and a recognisable organisational identity in the interior. An important insight from this case study is that the functional experience of the workplace - both at home and in the office - is reportedly strongly related to perceived productivity and perceived freedom of choice (Bergefurt et al., 2024). The lack of sufficient privacy and concentration spaces in the office may lead employees to choose to work from home sooner, since this space fulfils these needs better. The approach offers the opportunity to test in direct dialogue with users to tune out what works and what does not, as well as to ask about the underlying arguments. Future designers, facility managers and workplace managers may build on these insights by using the office as a living lab. By actively involving employees as co-researchers and co-designers, solutions can be tested and developed in a low-threshold manner. Design thinking in evidence-based research - where analysis and solution evolve simultaneously - can contribute to a flexible and iterative improvement process that increases ownership and commitment, at individual, team, and organisational level.

Limitations

The original design envisaged a broader population, but due to the slow return to office after COVID-19 and high workload within the organisation, the study had to be flexibly adapted. This limited the qualitative analysis but still allowed relevant insights to be gathered through an iterative process.

CONCLUSIONS

This case study shows that FM can improve hybrid work with spatial diversity. Customisation is key. Design interventions enable flexible, efficient space use and cost savings. Participatory approaches foster ownership and cohesion, helping FM in making the environment more engaging, supportive, and reflective of organisational identity through meaningful visual and spatial elements, ultimately fostering a vibrant and meaningful work environment.

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Community, Belonging, Hybrid Work – Does Working at the Office Help?

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ABSTRACT

Background and Aim. The amount of remote work in Finnish governmental organizations continues to be on a high level after the pandemic. In this paper following research questions are considered: 1) Does the sense of community and belonging in hybrid work differ between those who mainly work remotely and those who work in the office more? 2) Does the sense of community and belonging in hybrid work differ between those employees whose office is a co-working environment and those whose office is used only by a single organization?

Methods and Data. Data for the study was collected via personnel survey (n=1696) in Finnish governmental organizations between December 2023 and March 2025.

Results. Those who work only limited amount of their working time in the office had more positive experiences of sense of community and connectedness than those who work at the office more. There were minor differences in the experiences between those employees, whose office was shared co-working office and those whose office was used only by single organization.

Originality. This paper presents results from one of the first studies of hybrid work practices after pandemic and first study of a co-working environment fully shared with several organizations.

Practical Implications. Largely office-based work is not needed to maintain high sense of community and belonging in knowledge work.

Type of Paper. Short research

KEYWORDS. activity-based working, co-working, hybrid work, remote work, sense of community.

INTRODUCTION

When the remote work recommendations during the COVID-19 pandemic were lifted in the spring of 2022 and subsequently continued in so-called hybrid work, there has been relatively little empirical research from the post-hybrid work period. In the context of extensive share of remote work in hybrid work, there have been many public concerns about how collaboration, social relationships and community at workplaces will fare when less time is spent working together in the office at the same time.

Activity-based office environments with non-designated workstations have emerged as one response to the challenges experienced in traditional open-plan offices related to both individual work requiring silence and collaborative work requiring discussion in the office (Wohlers & Hertel, 2017). In an activity-based office environment, it is possible to free up the use of the physical work environment from organizational unit boundaries and enable the functional zoning of the entire work environment so that members of any organizational unit can equally use different zones. As a continuation of this type of shared use of physical office environment among Finnish governmental organizations, governmental co-working spaces have emerged, where multiple governmental organizations share and utilize the same activity-based work environment as their only and primary office work environment. The significance of physical space in delineating and marking boundaries and territories of different work groups has significantly decreased, alongside the rise of distributed, hybrid work (e.g. Choudhury, 2025). However, there have been many concerns about whether this has negative effects

on collaboration and community (e.g. Hyrynsalmi et. al 2025, Urrila et al., 2025). In this paper empirical research results concerning potential effect of both large-scale hybrid work and applying shared office work environments have on quality of collaboration, sense of community and connectedness are presented.

LITERATURE STUDY

The question of the impact of distributed work on the quality of collaboration and work communities, both from the perspective of the community and the individual, is a classic research topic and has been approached, among other things, under the title of distributed work research in the Computer-supported Cooperative Work (CSCW) field (e.g. Olson & Olson, 2000; Hinds & Kiesler (eds.) 2002).

When considering the effects of hybrid work on collaboration and community in knowledge work, one perspective for analysis can be the coordination mechanisms of distributed work (Franssila, 2017). Concerns about the impact of hybrid work on the smoothness of collaboration and community are most closely related to the fact that working in the same place at the same time has traditionally served as a strong means of coordinating collaboration and supporting community. However, the reality of work, especially in knowledge work and expert organizations in Finnish governmental sector, has long been evolving in a direction where geographical location, even on a small scale, does not matter in terms of who you work with. In the expert work where there are various ways to communicate digitally, both synchronously and asynchronously, the importance of spontaneous face-to-face communication has decreased (van Zoonen et al., 2025). It has become increasingly important for both work well-being and productivity to be able to structure one's availability so that there are periods when one is freely reachable and periods when one can focus and concentrate on individual tasks.

In the scientific discussion about the concurrent and future of hybrid work, the importance of diverse digital communication and presence means for maintaining and building relationships and communities has been highlighted (Leonardi et. al., 2024). It has also been observed that investing in better-structured shared time and the ability to protect periods of independent work has produced good results – both personal and group productivity has improved (Meyer & Fritz, 2025; Cross, 2022). Bernstein et al. (2024) suggest that new tools are needed to manage shared activities and shared attention. In the era of flattened organizations and even shared spaces, work communities face a growing risk of relational overload. New, dynamic agreements are needed - work communities should agree on means that enable mutually transparent availability, synchronous attentional allocation, and reciprocal attention allocation. Together these means enable transactive control of collective attention and mitigate relational overload. Mutually transparent availability refers to means and ways of mutually communicating availability within the work community and politely communicating when one wants to focus and thus be unreachable. Synchronous attentional allocation refers to practices that structure and agree on times and moments when work is done synchronously. Reciprocal attention allocation refers to practices and agreements that ensure the reciprocity of attention allocation asynchronously, as not all interaction is meaningful or possible to implement synchronously, again aiming to avoid the negative effects of shaping and possibly limiting interaction. Bernstein et al. (2024) suggest that research is needed on these new practices.

METHODS AND DATA

The empirical data for the study was collected between December 2023 and March 2025 from 10 locations in Finland. Responses of employees from 25 different governmental organizations were collected via online survey. Variable number of employees per organization worked in a single location depending on the size of the organization. Survey was directed to all organizations and employees working in each location. The survey was conducted in connection with the change management activities related to the workplace change project. Participation to the survey was voluntary. A total of 1689 responses were received. The response rate varied by organization from 20% to 100%. The survey reached employees from organizations already working in activity-based shared work environments

and organizations working in different types of single-organization physical office environments. The average share of the work time respondents worked at the office was 33% of their total working time.

A survey questions were designed to operationalize the perspectives of transactive control of collective attention and mitigating relational overload presented by Bernstein and colleagues (Bernstein et al., 2024) and the phenomena of collaboration and community in the hybrid work era. The questions of the survey dealing with hybrid work collaboration and community experiences included statements about experiences of collaboration and belonging practices and experiences regardless of location. Additionally, the survey included a section investigating work community practices related to the ability to reach colleagues, monitor the status of collaborative work, means to stay up to date what is happening in the work community, and the existence of communication channel agreements. Questions operationalizing the perceptions of physical workplace facilities from the Smart Ways of Working (SmartWOW) framework (Palvalin, 2019) were included into the survey.

The survey data was analysed by comparing group mean differences and correlation analysis in statement level, to provide detailed understanding to direct practical interventions aimed to enhance hybrid work practices in work community level. In statistical testing of group mean differences independent samples t-test was applied, which is recommended statistical testing method for to groups (IBM 2025). Analysis aimed to identify the dimensions of community experience where there may be differences between those working more and less in the office, as well as between those working in shared work environments and traditional single organization work environments. Correlation analysis was applied to further to detect potential co-variation between physical work environment experiences and experiences of transactive control of collective attention and mitigating relational overload among those who worked more in the office.

RESULTS

It appears that physical co-location itself does not provide advantages for experiencing sense of belonging or for the quality of collaboration in conditions where, on average, only about 1/3 of work time is spent at the office. Quite contrary, those working less at the office evaluate the quality of collaboration, sense of community and experiences of belonging more positively than those working more in the office (Figure 1 and Figure 2).

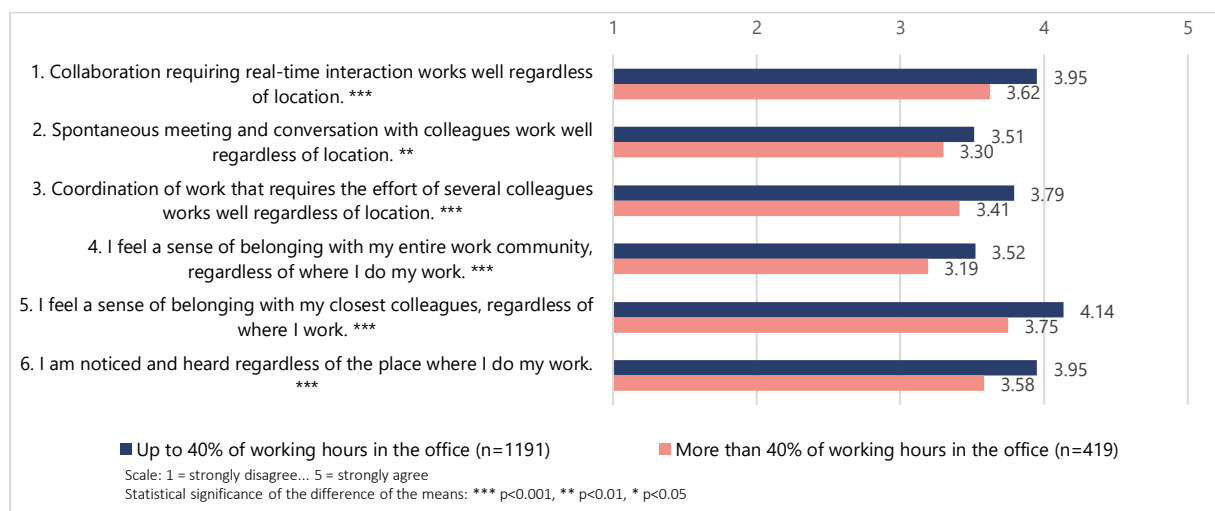


Figure 1 Sense of community and belonging – comparison between those working less and those working more of their working time in the office. Source: Authors' own work

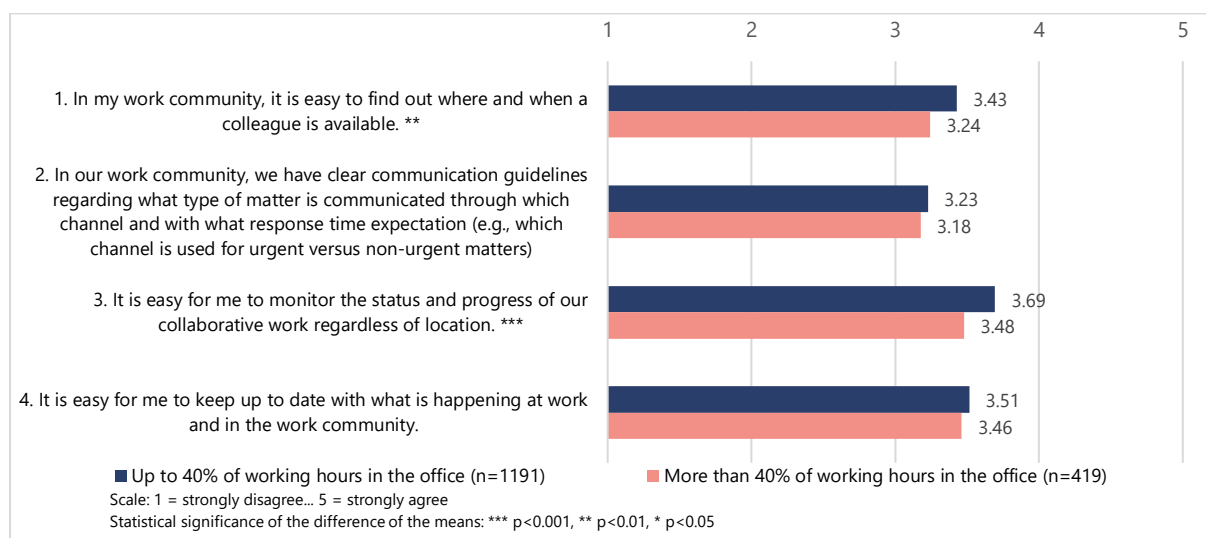


Figure 2 Experiences of transactive control of collective attention and mitigating relational overload – comparison between those working less and those working more of their working time in the office. Source: Authors' own work

In the correlation analysis it was observed, that for *those working more in the office* the perception of the characteristics of physical work environment *weakly correlated* with the sense of community. If it was perceived that the workplace facilities enable spontaneous interaction between employees and that the workplace facilities enable efficient work, also collaboration and sense of community regardless of the location were perceived more positively. On the other hand, experiences of transactive control of collective attention and mitigating relational overload *moderately correlated* with more positive collaboration and sense of community experiences regardless of the location.

Sharing office work environment with other organizations does not considerably affect how the quality of collaboration, sense of togetherness, and transactive control of collective attention and mitigating relational overload is observed. There are small differences in experiences of the ease of real-time interaction, coordination of work, and ease of tracking availability of the colleague between respondents working in different kinds of office environments (Figure 3 & Figure 4).



Figure 3 Sense of community and belonging – comparison between those working in single organisation environment and those working in work environment shared with multiple organisations. Source: Authors' own work

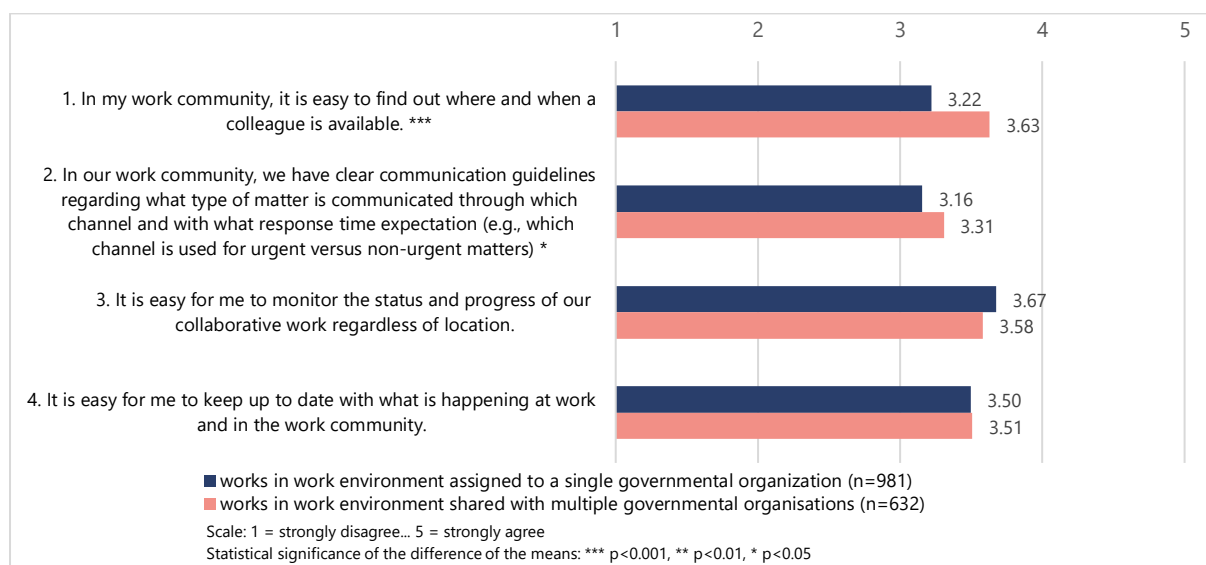


Figure 4 Experiences of transactive control of collective attention and mitigating relational overload – comparison between those working in single organisation environment and those working in work environment shared with multiple organisations. Source: Authors' own work

DISCUSSION

Transparent, mutual control of availability and collective attention seem to be important factors in ensuring a good sense of community for both those who work more and less in the office in hybrid work arrangements, as proposed by Bernstein et al. (2024). The study also showed that work environments shared with multiple organisations do not collapse the quality of collaboration and sense of community.

CONCLUSIONS

The results of this study showed that extensive hybrid work with a high proportion of remote work is not associated with any collapse in the quality of collaboration and sense of community in knowledge work communities. Maintaining the quality of collaboration and community in expert work communities does not require a broader return to office work – and not anymore the same amount of office space as before pandemic. On the contrary, the results indicated that more frequent office work was associated with slightly more negative experiences of location-independent collaboration and sense of belonging. However, those who worked more in the office were more satisfied with collaboration and community when they felt that availability of colleagues was easy to determine, and it was easy to stay updated on the status of collaborative work. The study was conducted in governmental organizations, which may limit the generalization of the results to the other contexts of knowledge work organizations.

AI DECLARATION

Artificial intelligence (AI) tools were applied for translations from Finnish to English and to literature search in this work.

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Two Types of Hybrid Workers: How Preferences Relate to Personal Characteristics, Living Conditions, and Workplace Satisfaction

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ABSTRACT

Background and Aim. In hybrid working, employees have the flexibility to choose between working from home or at the office. While previous studies have examined workplace preferences for hybrid working, less is known about whether distinct preference groups of employees can be identified and how these groups relate to individual characteristics, living conditions and current workplace satisfaction.

Methods and Data. This study conducted a discrete choice experiment with 1,258 employees from the Municipality of Amsterdam. Latent class analysis was applied to examine distinct workplace preferences among employees.

Results. This study reveals two distinct types of hybrid workers, home- and office-preferring. It shows that gender does not play a significant role, while age, education level, living conditions, and satisfaction with current home and office workplaces predict to which of these classes a worker is most likely to belong.

Originality. This study provides novel insights by identifying two distinct hybrid workplace preference classes linked to their personal characteristics, living conditions, and workplace satisfaction levels.

Practical Implications. Employees over the age of 55, with lower levels of education, living with children (and with a partner), and dissatisfied with their current office but satisfied with their home-workplace, show a strong preference for working from home. In contrast, younger employees with higher levels of education, living alone, satisfied with their office environment, and dissatisfied with the home workplace tend to prefer working at the office. These findings provide insights in preferences for office- and home-workplace settings, which can guide workplace designers to better support hybrid work.

Type of Paper. Full Research

KEYWORDS. hybrid work, latent class analysis, personal characteristics, preferences, workplace choice.

INTRODUCTION

Hybrid working has become widespread, particularly during and after the COVID-19 pandemic. In this way of working, employees typically have a mix of designated office workdays and flexible workdays, during which they have the autonomy to choose between working at the office or remotely. Research shows that remote working is associated with increased autonomy, reduced commuting, and improved well-being (Hopkins & Bardoel, 2023; Lewandowski et al., 2024), but also with social isolation and blurred work-life boundaries (Gualano et al., 2023). In contrast, working at the office is linked with enhanced social interaction and productivity (Emanuel et al., 2023; Gibbs et al., 2023) but may involve noise, limited privacy, and poor environmental conditions (Haapakangas et al., 2018). To fully

understand hybrid work dynamics, it would be important to explore how employees perceive and evaluate both home and office workplace settings at the same time, particularly on flexible workdays.

While there is an increasing amount of research on workplace preferences in hybrid work settings, it remains unclear how these preferences differ among employees, particularly when choosing between working in the office or from home. Considering that workplace experiences and preferences can be influenced by personal characteristics, including demographic factors (De Been & Beijer, 2014; Rothe et al., 2012), it would be important to understand how these factors may impact hybrid workplace preferences. Yet, the impact of these characteristics on employees' preferences, particularly in hybrid work settings, has been largely overlooked. Therefore, this study aims to identify distinct types of hybrid workers based on their workplace preferences, while considering their personal characteristics, living conditions, and satisfaction with their current home and office workplaces. Within this aim, a discrete choice experiment was conducted with 1,258 employees from the Municipality of Amsterdam and analysed with latent class analysis.

LITERATURE STUDY

Previous studies have examined employee preferences for various office attributes. For instance, preferences for *workspace type* is studied through workplace experiences. Some studies showed that single-office types are often preferred when employees need to carry out focused work tasks (Haynes et al., 2017). On the other hand, employees prefer open-office layouts for their positive impact on collaboration, although there are studies showing the potential negative impacts, as they may lead to distraction and stress for particular employees (Collins et al., 2016; Haapakangas et al., 2018). Preferences for *office-aesthetics* have been studied as well and showed potential psychological impacts on workplace experiences by the presence of plants, the type of colours, and the presence of art (Bjerke & Ind, 2015; Mastandrea et al., 2019). From a technology and office use point of view, preferences for *workspace reservation systems* (Buckman et al., 2014; Sinopoli, 2010) and the *technology level* (Jackowska & Luring, 2021; Tuzcuoğlu et al., 2022) in office environments are also highlighted as they can impact employees' experiences. Furthermore, preferences for the design of the *kitchenette areas* in the office environments would be significant, considering their potential in fostering the informal interaction and well-being (Danielsson et al., 2015; Tuzcuoğlu et al., 2021).

Despite the existing literature on experiences and preferences for office environments, it is not clear how these aforementioned office attributes affect employees' hybrid working preferences and whether there are distinct preference groups based on employees' personal characteristics, living situation and workplace satisfaction. In particular, regarding hybrid work preferences, studies suggest that personal characteristics may impact workplace preferences and experiences at home and at the office. For instance, a recent study suggests that gender and education level can contribute to the appeal of home-office arrangements. They show that employees with higher education levels (postgraduate degree) are found to use home-workplace alternatives more than those with lower levels (undergraduate degree) (Ollo-López et al., 2020). Another recent study conducted during the COVID pandemic shows that the presence and type of household members can shape employees' remote work experiences at home (Sridhar & Bhattacharya, 2021). Their study showed that, in particular, the number of elderly staying in the house negatively influences job effectiveness when working at the home-workplace. Thus, the presence of household members at home would be important to consider when employees make a choice between home and the office. Furthermore, previous research shows that employees' current satisfaction with their workplace plays a role in shaping their workplace experiences and preferences (Bellmann & Hübler, 2020). Yet, there is limited research examining how satisfaction with both office- and home-workplace environments influences hybrid workplace preferences.

A few recent studies have identified distinct workplace preferences linked to employees' individual characteristics (Furnham et al., 2024; Rauf et al., 2023). For instance, Appel-Meulenbroek et al., (2022) distinguished between employees who prefer working from home and those who prefer the office and found that the home-preferring employees are more likely to be female, part-time workers, or in

administrative roles. However, their study did not consider design features of the home workplace, the employees' living conditions, nor their satisfaction with current workplace experiences, both at home and in the office.

Altogether, this study aims to examine whether there are distinct preference groups and how these groups can be related to individual characteristics (gender, age, education level), living conditions, and current workplace satisfaction. Based on the literature review, this study addressed this aim by investigating hybrid workplace preferences for two attributes related to the home-workplace (i.e., presence of others, technology level) and seven to the office-workplace (i.e., workspace type, workspace access, office aesthetics, technology level, occupant type, kitchenette type, events).

METHODS AND DATA

Experiment design

A discrete choice experiment (DCE) was designed to examine workplace preferences for office and home environments through choice behaviour and to identify distinct groups of employees with shared preferences. This method was specifically chosen because it can effectively measure how individuals prioritise and make trade-offs between competing factors when making decisions by using hypothetical workplace alternatives and analysing responses to them (Hensher et al., 2015). Additional short questions were included alongside the DCE to collect individual characteristics from participants' demographics (e.g., age, gender), living conditions, and satisfaction with their current home and office environments.

In total, nine workplace attributes were evaluated in the DCE (seven office and two home-workplace attributes), see Table 1. A small subset of 16 combinations (out of 3072 possible combinations) was selected using an orthogonal fractional factorial design. Only office workplaces were presented as hypothetical environments, while home-workplaces referred to the respondents' existing home contexts with two additional attributes (Figure 1).

On this day, suppose you have no responsibilities at home such as shopping or childcare.
 WORKING TASKS: individual work & (online) meetings

Which workplace do you prefer on this day?



 <p>WORKPLACE</p>  <p>KITCHENETTE with sitting + gaming zone</p> <ul style="list-style-type: none"> Office floor shared with OTHERS - no direct colleagues Office has SMART TECHNOLOGY interactive, informative smart screens, smart workstation, meeting table with touchscreen Workplace (ONLINE) RESERVATION REQUIRED Organisation plans NO ACTIVITIES <p>workplace at OFFICE</p>	<p>WORKPLACE AT YOUR HOME Imagine that your current workplace at your home additionally has the features described below.</p> <ul style="list-style-type: none"> There are OTHERS at HOME - family member/s, housemate Your workplace at home has SMART TECHNOLOGY The employer provides the equipment, such as digital tools, meeting equipment and high-speed internet connection <p>workplace at HOME</p>	<p>No preference</p>
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Figure 1 Example of a choice task. Source: Author's own work

This approach aimed to simplify decision-making and avoid potential cognitive overload in the choice experiment (Himmler et al., 2021). Each participant was randomly presented with six choice combinations and asked to choose between working at the office, at home, or selecting the 'no preference' option. They imagined a workday with autonomy to choose their workplace, involving both individual work and online meetings without home responsibilities. Since visuals can convey environmental dynamics more effectively than text-based DCEs (Arellana et al., 2020), the most visually representative office attributes were rendered to present the kitchenette and individual workspace, with the aesthetics attribute embedded in them. The remaining four office and two home attributes were described in the text (e.g., smart technology, social events).

Data Collection and Analyses (modelling choice behaviour and individual characteristics)

Employees of the Municipality of Amsterdam were invited to participate in this research via an online survey link between 11 September and 9 October 2023. In total, 1,258 employees participated in the online experiment (Table 1). Participation was voluntary, and participants gave consent on the online form at the beginning of the survey before completing the experiment.

Latent class (LC) models are used to estimate preferences for different alternatives by multiple groups (classes) in the sample. Although AIC/BIC was lower for the three-class LC, one of the classes became very small, so the LC model with two classes was chosen. The two-class LCs provided the most distinct and interpretable preference patterns. For each class c , the utility of each alternative is defined as follows:

$$V_{office|c} = \beta_{1|c}X_1 + \beta_{2|c}X_2 + \dots + \beta_{7|c}X_7$$

$$V_{home|c} = \beta_{home|c} + \beta_{8|c}X_8 + \beta_{9|c}X_9$$

$$V_{none|c} = \beta_{none|c}$$

$\beta_{k|c}$ measures the contribution of attribute k to the utility of the office or home alternative. $\beta_{home|c}$ refers to the base utility of the home alternative relative to the office alternative. $\beta_{none|c}$ represents the utility of the 'no-preference option' when choosing between the office alternative and home. All β -parameters are estimated for each class c . The probabilities of choice can be derived from the utility function, for example, for each class segment c , the probability that an employee q chooses the office workplace is defined as:

$$p_{office,q|c} = \frac{\exp(V_{office|c})}{\exp(V_{office|c}) + \exp(V_{home|c}) + \exp(V_{none|c})}$$

The probability that an employee q belongs to a particular class c is assumed to depend on some personal characteristics (demographics, living situation, and workplace satisfaction):

$$P_{qc} = \frac{\exp(\sum_j \theta_{jc} Z_{qj})}{\sum_{c'} \exp(\sum_j \theta_{jc'} Z_{qj})}$$

Z_{qj} represents the j^{th} personal characteristic of employee q

θ_{jc} is a parameter for the j^{th} personal characteristic for class c

Finally, the probability that the office alternative will be chosen by employee q is equal to:

$$p_{office,q} = \sum_c p_{office,q|c} P_{qc}$$

Note that the θ -parameters (related to personal characteristics) will be equal to 0.0 by definition for the second (last) class. Furthermore, effect-coding is used to estimate the relative importance (utility) of attribute levels and their influence on workplace choice behaviour. For example, in the case of an attribute with four levels, three dummy variables are created: each takes the value of 1 when the corresponding level is present and 0 otherwise. For the reference level, all three variables are set to -1, ensuring that the average utility across levels remains zero. The personal characteristics are also effect-coded.

RESULTS

In the experiment, there were slightly more women (58.7%) than men (39.3%). During the initial LC model estimations, gender did not significantly contribute to class membership, while several other variables were found to be significant. Therefore, the most optimal two-class LC model is used, generated without gender, as it demonstrated an excellent fit, as indicated by its McFadden Rho-squared adjusted value ($\rho_{adj}^2 = 0.413$). Table 1 shows the estimated preferences (β) for attribute levels across the two latent classes and the class membership parameters of individuals belonging to each class based on their characteristics (personal characteristics, living conditions, satisfaction level, θ). The preferences of two latent classes are depicted also in Figure 2.

The two classes had distinct base preferences regarding home-workplace versus office-workplace choices. Class 01 ($\beta_{home|01} = 2.014$) demonstrated a base preference for working from home, while Class 02 ($\beta_{home|02} = -0.846$) showed a stronger inclination toward working at the office. The class membership probability for each participant showed that Class 01 (home-preferring) represents 57.5% of the sample, while Class 02 (office-preferring) accounts for 42.5%. The utility of choosing 'no preference' was negative for both classes ($\beta_{none|01} = -1.970$ and $\beta_{none|02} = -2.598$), indicating that the workplace options were clearly defined and that the experimental setup effectively encouraged participants to make specific choices rather than opting out. All included personal characteristics, living conditions, and workplace satisfaction variables (shown in Table 1) shape preferences.

Differences between the two classes emerged in preferences for smart technology. For individuals preferring to work from home (Class 01), the presence of smart technology enhanced the attractiveness of the workplace environment both at home ($\beta_{smart-home|01} = 0.141$) and at the office ($\beta_{smart-office|01} = 0.190$). In contrast, smart technology did not seem to influence the office-preferring group (Class 02). For both classes, having other people at home made working from home less appealing, but this impact was stronger amongst those preferring to work at the office ($\beta_{others\ present|02} = -0.289$) than from home ($\beta_{others\ present|01} = -0.164$), suggesting that individuals who already have a base preference for the office were even more discouraged from choosing to work at home when others are present.

Regarding the office-workplace, preferences clearly differ between both classes for single-offices with solid walls. Individuals belonging to the office-preferring group were more likely to prefer this office option ($\beta_{single\ office|02} = 0.185$), while it did not matter for the home-preferring group. This suggests that those with a base preference for the office are more likely to value the privacy and separation offered by single-offices with solid-walls. Furthermore, an open-office with half-walls made the office option less attractive for both groups, but this impact was stronger for those who prefer working from home ($\beta_{open\ office|01} = -0.214$) than at the office ($\beta_{open\ office|02} = -0.134$). Thus, individuals with a base preference for the home workplace were less likely to choose the office workplace when there are open offices with half-walls.

Both groups of employees are most likely to prefer office-workplaces shared with direct colleagues, but this preference was stronger amongst those preferring to work from home ($\beta_{direct\ col|01} = 0.608$) than in the office ($\beta_{direct\ col|02} = 0.410$).

In terms of office events, both groups showed a clear dislike for having no events at all, but this dislike was stronger amongst those preferring to work from home ($\beta_{no-events|01} = -0.582$) than in the office

($\beta_{no-events|02} = -0.213$). Social activities appear to make the office environment more appealing for both groups, but again this preference was stronger for the home-preferring group ($\beta_{social\ events|01} = 0.401$) than the office-preferring group ($\beta_{social-events|02} = 0.187$). Lastly, an interesting finding was related to the kitchenette area. The preferences for the design of the kitchenette did not seem to differ much among the two-classes, except that the individuals preferring to work from office had a significant preference for a kitchenette with a sitting and gaming area ($\beta_{kit-gaming|02} = 0.127$), meaning that social and recreational office spaces make the office environment more attractive for those preferring to work from home.

Individual characteristics

The θ -parameters (Table 1) indicate how the personal characteristics affect the membership of each latent class. Positive values for class 01 (home-preferring group) indicate higher probabilities of belonging to this class, while negative values indicate higher probabilities of belonging to class 02 (office-preferring group). θ -parameters for the second class are 0.0 by definition in logistic regression models. The negative constant value for class 01 ($\theta_{constant|01} = -0.975$) in LC analysis reflects unmeasured factors that influence class membership, indicating a higher likelihood of being in class 02, independent of personal characteristics.

Individuals with the highest probability of belonging to Class 02 (the office-preferring group) were younger individuals aged 18 to 35 ($\theta_{18-35|01} = -0.269$), holding a master's or doctorate ($\theta_{masters/doctorate|01} = -0.458$), living alone ($\theta_{living\ alone|01} = -0.292$), (very) satisfied with their office ($\theta_{satisfied-office|01} = -0.406$), and (very) dissatisfied with their home workplace ($\theta_{dissatisfied|01} = -2.098$). On the other hand, those more likely to belong to Class 01 (the home-preferring group) were holding a high school/vocational education or Bachelor's degree ($\theta_{highschool.vocational|01} = 0.262$), (very)

Table 1 Latent class logit model (LCM) preferences

Attributes	Levels	CLASS 01	CLASS 02
		Home-preferring	Office-preferring
	Class membership probabilities (%)	57.5	42.5
β_{none}	No-preference alternative	-1.970***	-2.598***
Office			
Workspace type	Single-office with solid walls	0.025	0.185**
	Single-office with a glass wall	0.056	0.099
	Open office with half-walls	-0.214*	-0.134*
	Open office with no separation	0.133	-0.150
Workspace access	(online) Reservation is required	-0.095	-0.030
	Reservation is not possible	0.095	0.030
Office-aesthetics	Warm colours, presence of plants, art objects	-0.079	0.030
	Cool colours, no plants, no art objects	0.079	-0.030
Technology level	Smart technology	0.190***	0.066
	Basic technology	-0.190	-0.066
Other occupants	Direct colleagues	0.608***	0.410***
	Others	-0.608	-0.410
Kitchenette type	Kitchenette with standing tables	-0.048	-0.054
	Kitchenette with sitting area	0.151	0.097
	Kitchenette with sitting&gaming area	0.004	0.127*
	Kitchenette-only	-0.107	-0.170
Events	No-events	-0.582***	-0.213***
	Social events	0.401***	0.187***
	Wellness events	0.181	0.026

Home				
β_{home}	Constant of the home alternative		2.014***	-0.846***
Presence of others	Others present		-0.164**	-0.289***
	No presence of others		0.164	0.289
Technology level	Smart technology		0.141**	0.064
	Basic/regular technology		-0.141	-0.064
Estimated class membership				
Characteristics	(N=1258)	%	θ_{j01}	θ_{j02}
Constant			-0.975***	0
Age	18-35	20.2	-0.269*	0
	36-45	21.9	-0.014	0
	46-55	27.6	0.077	0
	55+	29.5	0.205	0
Education level	High School / Vocational education	16.8	0.262*	0
	Bachelor's degree	34.5	0.196*	0
	Master's / doctoral degree	44.3	-0.458***	0
Living condition	I live alone	19.8	-0.292**	0
	I live with my partner/housemate(s)	34.5	0.166	0
	I live with child(ren) & with/out partner	44.2	0.126	0
Satisfaction with the current office	(very) Satisfied	34.3	-0.406***	0
	Neutral	30.1	0.088	0
	(very) Dissatisfied	35.5	0.317***	0
Satisfaction with the current home	(very) Satisfied	74.9	1.808***	0
	Neutral	15.7	0.289	0
	(very) Dissatisfied	7.9	-2.098***	0
Statistics	Log-likelihood of the estimated model		-4826.529	
	McFadden's Rho-square		0.418	
	McFadden's adjusted Rho-square		0.413	
	Number of observations		7548	
	AIC (per observation)		1.291	
Significance *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$				

dissatisfied with their current office ($\theta_{disatisfied-office|01} = 0.317$), and (very) satisfied with their home ($\theta_{satisfied-home|01} = 1.808$).

Regarding age, starting with a significant negative value for the youngest group, the values increase with increasing age. Although these values are not statistically significant, they suggest a tendency: individuals aged above 55 and between 46-55 have positive values ($\theta_{55+|01} = 0.205$, $\theta_{46-55|01} = 0.077$) for belonging to Class 01 (to the home-preferring group), while those aged between 36-45 and between 18-35 have a negative value ($\theta_{36-45|01} = -0.014$, $\theta_{18-35|01} = -0.269$), a tendency to belong to Class 02 (the office-preferring group). Furthermore, those living with children with or without a partner ($\theta_{with\ children,partner|01} = 0.126$) or those living with a partner or house mate ($\theta_{with\ partner/housemate\ children,partner|01} = 0.166$) have positive values for belonging Class 01 (to the home-preferring group).

DISCUSSION

This study aimed to identify distinct types of hybrid workers while considering their workplace preferences, personal characteristics, living conditions, and satisfaction with current home and office workplaces. The findings revealed that there are two types of hybrid workers, home-preferring and office-preferring, and employees are not uniform in how they approach the choice between working from home or in the office. Instead, their preferences are diverse and shaped by a range of personal characteristics, living situations, and levels of satisfaction with their current workplace environments at home and the office. The insights from this study offer valuable guidance for workplace designers

and managers seeking to develop hybrid workplace strategies that are responsive to the varied needs and preferences of employees.

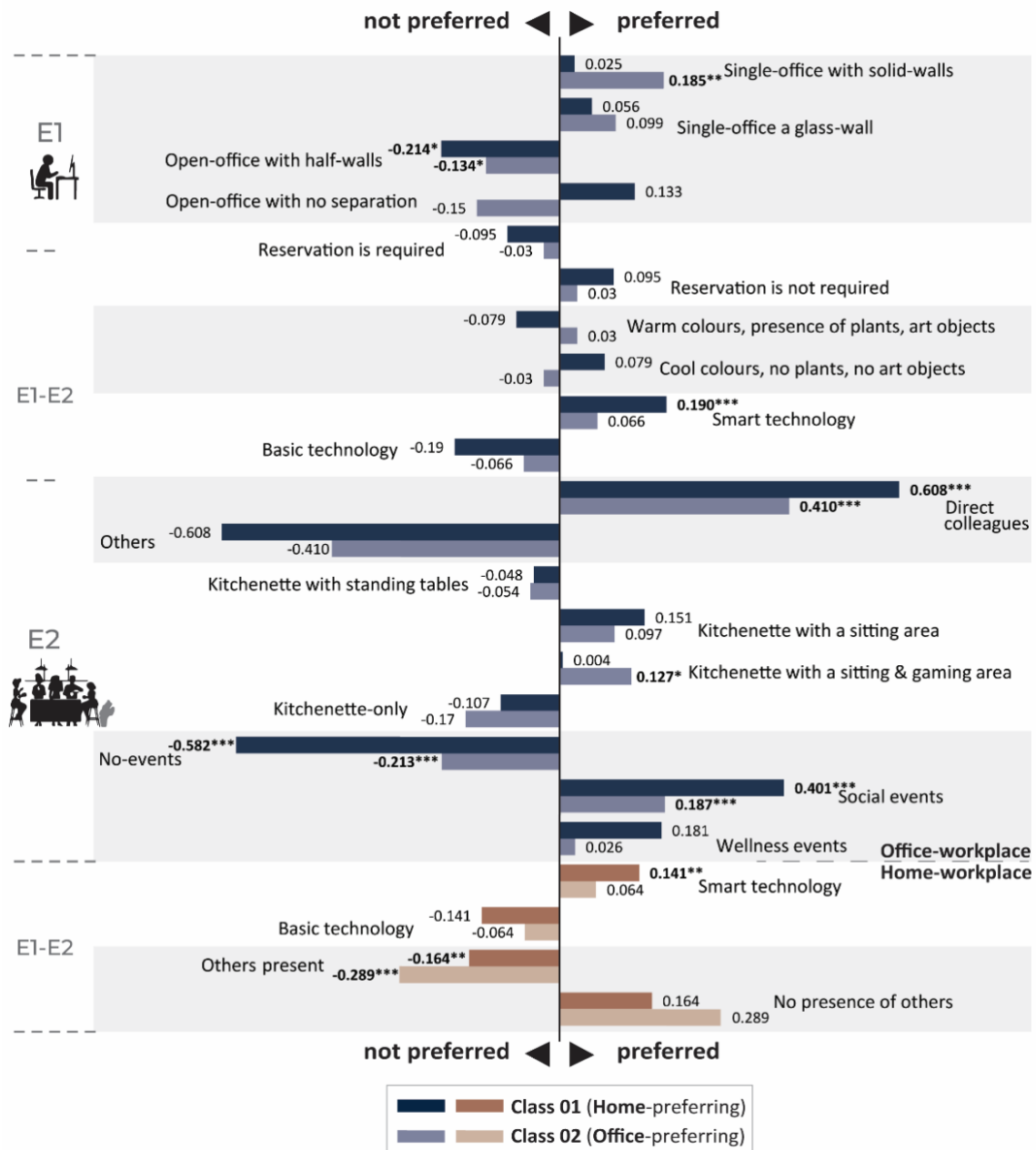


Figure 2 Preferences (β) of two latent classes. Source: Authors' own work

Younger and higher-educated employees tend to prefer working at the office

In contrast to earlier studies (e.g., Appel-Meulenbroek et al. 2022), this study shows that *gender* does not significantly influence hybrid work preferences. However, it reveals that *age* plays a role in shaping these preferences. Particularly, younger employees are less likely to choose to work from home. This can be related to several things. For instance, younger employees' tendency to work at the office could be related to their aim to gain experience and build professional networks. Additionally, employees with higher levels of education seem to be more inclined to prefer working from the office. This could

be related to their job tasks, as managerial responsibilities may induce employees to come to the office more frequently than others.

Employees who live alone are more likely to prefer working at the office

While previous studies have highlighted how living conditions may influence the home workplace experience, such as distractions (Sridhar & Bhattacharya, 2021), this study contributes to the literature by showing that living conditions also shape employees' workplace choice decisions when deciding between home and the office. Employees who live alone are more likely to prefer the office. In contrast to previous studies that emphasise the distractions or discomfort caused by others being at home, this study suggests that the presence of other household members may actually encourage individuals to choose home over the office. This tendency to prefer the home workplace may be linked to childcare responsibilities and other domestic obligations. Despite the potential for distractions, employees may find ways to manage these challenges, possibly by compensating with more flexible work hours or adjusting their work processes. Furthermore, the tendency to work from the office when living alone may be related to the need for social interaction or a more structured work environment, which the office can provide. For individuals living alone, the office might also serve as an important space for daily routine, engagement, and separation between work and personal life.

Higher satisfaction level with the workplace makes the workplace option more attractive

This study showed that employees with higher satisfaction with their current home-workplaces tend to prefer the home-workplace option. This tendency to work from home would be related to individuals' satisfaction with the autonomy, comfort, and support of their home settings (Lewandowski et al., 2024). Employees who are (very) satisfied with their current office environment are more likely to prefer working from the office. This supports previous studies that highlight the importance of office workplace satisfaction in enhancing both employee experience and productivity (Oswald et al., 2015). As a result, these employees may be more inclined to choose the office as their preferred workspace.

Specific workplace preferences: difference between office-preferring and home-preferring workers

Employees who prefer working from home tend to place a higher value on the availability of smart technology at home and in the office. They also seem to prioritise sharing the office with direct colleagues and the organisation of social events more than those in the office-preferring group. This may suggest that home-preferring employees seek stronger incentives to come to the office, in contrast to those who already have a high tendency to work there. The office-preferring group appears to place a higher value on the availability of single-office options in the workplace. Interestingly, they also show more tolerance toward open-office layouts with half-walls.

CONCLUSIONS

This study identified two distinct groups of employees, home-preferring and office-preferring, based on their workplace preferences and individual differences in a hybrid working context. While gender did not play a significant role, differences in age, education level, living condition, and satisfaction with current home and office workplaces contributed to shape these preferences. Most likely to belong to the office-preferring group are the employees under the age of 35, with higher levels of education, living alone, satisfied with their office-workplace, and dissatisfied with their home-workplace. Most likely to belong to the home-preferring group are the employees with lower levels of education and dissatisfied with their current office but satisfied with their home environment. These insights contribute to the literature on hybrid work by highlighting the importance of individual differences when designing work environments to support a variety of employee needs and preferences. The results also provide insights for the preferences for office and home workplace settings, which can guide workplace managers and designers to better support hybrid work.

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Environmental Crafting at Work: Learning from Autistic Individuals in Diverse Contexts

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ABSTRACT

Background and Aim. Despite their skills and motivation to work, autistic individuals often struggle to find suitable employment. The physical workplace poses specific challenges that have not been fully explored. We investigate how autistic people manage their working conditions by engaging in diverse forms of environmental crafting.

Methods and Data. We adopt a participatory research approach, collaborating with the autism community (autistic people, their allies, autism researchers) in all research phases. We employ qualitative methods including secondary analysis of reports on building visits with autistic user/experts, semi-structured interviews and/or photovoice with autistic individuals in various workplace contexts (office, home office, school, university buildings).

Results. Autistic people manage their working conditions in diverse ways, engaging in (1) approach-resources crafting by creating comfortable places to work, for themselves and others, (2) approach-demands crafting by addressing hindering indoor environmental discomfort, and (3) avoidance-demands crafting by avoiding spaces and preparing to minimize unpredictability. The ways in which autistic people manage the workplace show resourcefulness and deliberate effort in using, appropriating, and adapting the work environment to meet their needs.

Originality. Our findings provide a more nuanced view on the different forms of environmental crafting—not only mitigation of environmental demands but also strategies used by autistic individuals to enhance environmental resources. We highlight the importance of considering autistic people's agency and their contribution to workplace accommodations.

Practical Implications. Understanding how autistic individuals manage their workplace in diverse contexts aims to support them and may help different stakeholders in the workplace to address autistic people's needs.

Type of Paper. Full research

KEYWORDS. autism, environmental resources-demands model, inclusive workplace design, job crafting, neurodiversity

INTRODUCTION

Historically, autism research has primarily aimed to understand the causes of autism or to develop interventions to make autistic individuals 'less autistic' (Fletcher-Watson et al., 2019; Hens, 2021). Recently, there has been a shift from this medical model towards a neurodiversity-oriented model. This perspective views autism as a natural variation within a diversity of minds, where autistic sensorimotor atypicalities are one of many gradually distributed sensorimotor differences among humans—like differences in height (van Es & Bervoets, 2021), which play a role in the everyday interactions with the social and built environments. The neurodiversity paradigm thus prioritizes the

lived experiences of autistic individuals, focusing on understanding the challenges they face in daily life (Pellicano & den Houting, 2021). One significant challenge is the difficulties encountered in the workplace, since autistic individuals often face high unemployment rates and are frequently overqualified for their positions (Goldfarb et al., 2024; Scott et al., 2019).

Individual differences influence how people experience and interact with their work environment (Oseland, 2021). Both physical and social characteristics of a workplace contribute to the autistic individual-workplace (mis)alignment and consequently, their successful employment and well-being at work (Khalifa et al., 2020; Southey et al., 2024). Yet, the (un)supportive role of the built work environment (i.e., spatial design and indoor environmental quality of a physical work environment) is underresearched. Our research project 'Making room for autism at work' addresses this gap by investigating the role of the built work environment in how autistic people experience and manage their working conditions (Jelić et al., 2024). By considering autistic individuals as 'user/experts' (Ostroff, 1997)—i.e., individuals who can offer unique insights based on their acquired expertise-by-experience through everyday interactions with the built (work) environment, we investigate two aspects. First, the experiential aspect: we explore autistic people's workplace experiences to identify spatial aspects that support or hinder their work activities and interactions. This includes aspects like workplace location, spatial layout, interior design, indoor environment and its sensory qualities (e.g., temperature). Second, the managing aspect: we seek to understand how autistic individuals manage their working conditions by looking at how they use, appropriate, and adapt their work environment to meet their needs—or, in other words, engage in environmental crafting. Within the Environmental Demands-Resources model (Roskams & Haynes, 2021), environmental crafting is conceived as workplace behaviors aiming to minimize demands and maximize resources to create a suitable working environment.

In this paper, we focus on the 'managing' aspect and present our preliminary findings on how autistic people engage in environmental crafting to manage their working conditions. This focus has a twofold motivation. On the one hand, existing scholarship has highlighted the potential of physical workplace accommodations for autistic employees (Khalifa et al., 2020; Weber et al., 2022). Yet, the emphasis is predominantly on addressing environmental demands related to sensory experiences (e.g., dealing with noise levels and lighting), whereas research on autistic people's experiences in different contexts revealed that other spatial aspects matter as well (Nguyen et al., 2024; Tackx et al., 2022). On the other hand, there is very limited attention for the 'managing' aspect compared to the 'experiencing' one: what autistic people do with the workplace support and how they deal with unsupportive work environments remains underexplored. Through our preliminary findings, we seek to illustrate the variety of environmental resources and demands that autistic individuals experience in a work environment—including looking beyond the sensory (dis)comforts. Moreover, our aim is to provide a more nuanced view on the different forms of environmental crafting—not only mitigation of environmental demands but also strategies to enhance environmental resources.

In the following sections, we start by outlining the theoretical framework—the Environmental Demands-Resources model and the concept of job crafting—which informed our analysis of environmental crafting examples across the project's four substudies. Next, we describe our research approach and key research design characteristics. We present our preliminary findings on the variety of environmental crafting strategies autistic participants use in diverse workplace contexts (office, home office, school, university building) and employment types (paid and voluntary work). Finally, we highlight the importance of considering autistic people's agency and contribution to workplace accommodations, with practical implications for different stakeholders in the workplace such as autistic people's co-workers, managers, workplace designers, and facility managers.

THEORETICAL FRAMEWORK

Our perspective on the experiences of autistic individuals in the workplace is grounded in the Job Demands-Resources (JD-R) theory, a widely applied model in occupational health psychology to study the relationships between job characteristics and work outcomes. The JD-R theory posits that

job demands (aspects of work that require sustained physical or mental efforts) contribute to stress and health problems, while job resources (aspects that support work goals or personal development) enhance motivation and productivity (Bakker & Demerouti, 2017). Importantly, the JD–R model is flexible—it does not prescribe inherently positive or negative job characteristics, but instead considers how each characteristic may act as either a demand or a resource depending on individual needs and contexts. This flexibility makes the theory broadly applicable and valuable for understanding how neurodivergent workers, including autistic individuals, interact with their work environment.

To identify supportive and hindering aspects of the built work environment for autistic individuals we use the Environmental Demands–Resources (ED–R) model, which extends the JD–R framework by explicitly incorporating the physical work environment as part of the employee–workplace relationship (Roskams & Haynes, 2021). According to this model, *environmental demands* are features of the workplace that can impair health or performance (e.g., noise, crowding, poor ergonomics), while *environmental resources* support motivation and comfort (e.g., quiet zones, adjustable lighting, spatial privacy). Moreover, as introduced above, to mitigate environmental demands and/or enhance environmental resources employees may engage in *environmental crafting* (Roskams & Haynes, 2021). This concept positions (autistic) employees as active agents who shape their workplace to better align with their needs rather than passive recipients of their surroundings.

Complementing ED–R, we draw on the broader theory of *job crafting*—defined as the ways in which employees modify aspects of their job to better fit their personal strengths, needs, and preferences (Tims & Bakker, 2010). Zhang and Parker’s (2019) hierarchical model of job crafting further distinguishes between *approach crafting* (seeking out positive aspects of work through effortful and directed actions) and *avoidance crafting* (reducing or escaping negative aspects), each of which can be behavioral or cognitive, and either resource-focused or demand-focused. Combined with the notion of environmental crafting as *workplace behaviors* that seek to minimize environmental demands and/or maximize environmental resources, we highlight four job crafting types from their model (Zhang & Parker, 2019):

- *Approach resources crafting* (behavioral) involves actions to gain job resources;
- *Approach demands crafting* (behavioral) involves actions to increase one’s challenging demands or address hindering demands;
- *Avoidance resources crafting* (behavioral) refers to withdrawing from activities that lack value or fail to contribute to learning or goal achievement;
- *Avoidance demands crafting* (behavioral) involves actions to avoid hindering demands.

In this paper, we consider the ED–R model’s environmental crafting together with these four types of approach/avoidances D–R job crafting to gain a nuanced understanding of environmental crafting strategies autistic individuals use to manage their working conditions (see §Methods and data).

METHODS AND DATA

Research design: participants, work environments, methods

The ‘*Making room for autism at work*’ project adopts a participatory research approach: we include the autism community (i.e., autistic people, their allies, and autism researchers) in all research phases—research design, data collection, data analysis, and quality assurance (Jelić et al., 2024). In this way, our project considers autistic people’s voices as central in both its focus and research approach. On the one hand, we foreground the first-person experiences of autistic individuals by considering them as user/experts in their built work environments. On the other hand, we ensure that autistic voices shape what is researched and how (Fletcher-Watson et al., 2019). The project’s methodological approach is informed by the team members’ past research (e.g., Nguyen et al., 2024; Tackx et al., 2022), by recommendations and best practices for participatory research available within autism scholarship

(Fletcher-Watson et al., 2019; Gowen et al., 2019), and by feedback we received from the autism community on the research design (Jelić et al., 2024).

In this paper we present preliminary findings based on four parallel substudies within this ongoing research project, which started in October 2023. Table 1 provides an overview of the four substudies and their key research design characteristics. A more detailed description of each study and its data analysis protocol is beyond the scope of this paper; substudy 1 (Nguyen et al., 2025) and substudy 2 (Denys, 2024) are otherwise available, whereas manuscripts on substudies 3 and 4 are currently in preparation. For the overall research design, we adopt a two-track research strategy; for a more detailed research design description of the project, please see (Jelić et al., 2024).

The *Autistic people* track (AP Track; different individuals, different work environments) investigates which spatial aspects in the built work environment are important for autistic people; how these aspects support or hinder them in their work activities and interactions; and how they deal with the (un)supportive spatial elements. Within this AP track, we take an open-ended *qualitative approach* and offer a range of methods for the participants to choose from—including semi-structured and go-along interviews, visual methods (e.g., drawing, photovoice, videovoice), text-based methods (e.g., diary, poems, and other forms of written expression), and participant observations in the workplace. Additionally, one substudy employed a qualitative analysis of secondary sources—student reports based on visits to university and public buildings, conducted together with autistic user/experts within a master’s course on inclusive design at KU Leuven.

The *Built work environment* track (BWE Track; different individuals, same work environment) investigates differences and similarities in how autistic people and their co-workers experience the indoor environment and its sensory qualities within a specific work environment. It also examines the role of the workplace design in facilitating or hindering the adaptive strategies they use to manage environmental (dis)comfort. Within this BWE track, we employ a *mixed-methods approach* with sequential explanatory design with two-phased data collection: (1) a quantitative phase, including sensor-based IEQ measurements (e.g., temperature, light and sound levels), experience sampling to capture participants’ experiences of indoor environmental comfort and satisfaction, and sensory sensitivity measures; and (2) a qualitative phase, including semi-structured interviews to gain insights into participants’ experiences and adaptive strategies.

While each substudy focuses on specific participants, work environments, and methodological approach (Table 1), together they illustrate the project’s intention to research diverse types of work experiences (e.g., paid jobs, self-employment, voluntary work) and diverse work environments (including workplace contexts beyond the office space). We recruit individuals ≥18 years old, with and without intellectual impairment, who have an autism diagnosis, self-identify as autistic, or are seeking/awaiting a diagnosis. Substudies 1, 3, and 4 envisage including secondary participants i.e., the allies of autistic participants such as their co-workers, (job) coaches, managers/employers, and HR personnel. The research setup ensures due care for participants’ autism (non)disclosure at their workplace by adapting the research methods to protect their privacy and disclosure preferences. The four substudies were approved by the KU Leuven’s Social and Society Ethics Committee (G-2023-7542-R2(MIN), G-2024-7716-R2(MIN), and G-2023-6975-R2(MIN)).

Table 1 Overview of four substudies and their key research design characteristics

Sub study (Sn) & Track	Methodological approach	Work environment	Participants & employment type *names are pseudonymized unless participant chose to remain identifiable
SI	Qualitative multiple case study	Office space &	Voluntary work
AP	Semi-structured interview, photo voice, &	home office	Pinky* & Steve*
Track	participant observation		

S2 AP Track	Qualitative multiple case study Semi-structured interview & photo voice	<i>School (high school, adult education), after-school tutoring & home office</i>	<i>Paid job & self-employment</i> Bart*, Emma, Sabine, Sophie*
S3 AP Track	Qualitative analysis of secondary sources (i.e., written student course reports based on building visits together with autistic user/experts)	<i>University & public buildings – examples used from office spaces</i>	<i>Autistic user/experts imagined different roles during building visits (e.g., first-time visitor, staff member)</i> Hasse, Helena, Pieter*, Thomas*, Wout, etc.
S4 BWE Track	Qualitative phase within mixed-methods approach Semi-structured interview	<i>Office space</i>	<i>Paid job (full-time & part-time)</i> Laura*, Lucas*, Maxim*

Data analysis

In this paper, we include as data the identified examples of environmental crafting by autistic participants within the four substudies, based on interview transcripts and/or results of individual substudy analysis. These examples provide insights across different work environments and employment types, creating a richer dataset than available within each substudy. This allows us to gain a nuanced and more robust understanding of how autistic individuals engage in different forms of environmental crafting. For data analysis, we employed the ED-R model's environmental crafting with the four types of approach/avoidance D-R job crafting together as a sensitizing background (§Theoretical framework). Based on this framework, we mapped environmental crafting examples according to the four job crafting types (approach resources, approach demands, avoidance resources, avoidance demands crafting). The following section reports on the observed patterns.

RESULTS

In this section, we present our preliminary findings on the variety of environmental crafting strategies used by autistic participants in different workplace contexts and employment types. Our analysis identified strategies in three out of four job crafting types; no examples thus far fitted the avoidance resources crafting. Table 2 provides an overview of preliminary findings, which are described in more detail and exemplified below.

Approach resources crafting is manifested in strategies that enable autistic people to create job resources such as comfortable places to work. Creating a personal comfort zone to be able to focus on work is a strategy employed by several participants:

- In Sabine's and Sophie's *home offices* having a desk facing a wall is important for focused work. When she works, Sabine prefers to face a blank, preferably white, wall. Her desk is located in the living room and is removable thanks to a custom system designed by her father-in-law. To maintain a seamless look, the desk height matches that of the half-wall behind it, creating a single uninterrupted plane (Denys, 2024).
- Bart and Sophie highlighted the value of personal items for bringing warmth and comfort to their *home offices*. 'The little things that make your environment' create an inviting space for Bart to work comfortably and stay focused (Denys, 2024). Similarly, Pinky has crafted a comfortable zone in *her wheelchair* by keeping essential things close at hand such as tissues, lip gloss, water, glasses, a laptop, and other necessities (Nguyen et al., 2025). These personal belongings serve as environmental resources enabling them to focus on work.

Sophie's example illustrates the resourcefulness of autistic individuals to leverage their own experiences to create comfortable places to work for others. Sophie, who provides after-school guidance to help autistic students, has used her own autism to adapt her *home workplace* in a way

that energizes her and her students. On the ground floor, Sophie has set up her practice with different zones: a painting zone at the street side, where students can express their creativity; a guidance area at the garden side; and a therapy room in between. Each space has adjustable lighting, and although personal touches are present, Sophie tries to offer a calm/'low-stimulus' environment (Denys, 2024).

Table 2 Preliminary findings on the variety of environmental crafting strategies per job crafting type

Approach resources crafting i.e., strategies that enable autistic people to create job resources
Creating a personal comfort zone to be able to focus on work (examples: positioning the working desk to face a wall; displaying personal items in the home office)
Creating a comfortable place to work for others using own experience (example: creating different zones in the home workplace for after-school tutoring of autistic students)
Using workplace features to facilitate high-quality relationships with colleagues, as a non-environmental job resource (example: using the open-office layout to engage socially with co-workers)
Approach demands crafting i.e., strategies autistic people use to address hindering demands
Addressing indoor environmental discomfort and sensory stimuli by using personal items or by adjusting the workspace (individually or together) (<i>examples: using headphones or earplugs to limit the workplace sounds; together with colleagues removing some of the lights from the office ceiling to create dimmer conditions; storing items in personal work storage to help manage sensory stimuli</i>)
Finding opportunities to retreat (<i>example: using secluded corners and different room types that offer opportunities for withdrawal</i>)
Helping others address their indoor environmental discomfort (<i>examples: bringing earplugs for students who are easily overstimulated; as a chairperson experimenting with different meeting rooms to better accommodate the needs of autistic working group members</i>)
Avoidance demands crafting i.e., strategies autistic people use to avoid hindering demands
Avoiding spaces by choosing when (not) to work in a space, or avoiding it altogether (example: working from home to avoid too hot conditions in the office during summer; using a 'quiet room' for teachers later in the day when it is nearly empty)
Minimizing unpredictability through preparation and by choosing familiar spaces (example: planning the commute to work by doing a test run; minimizing uncertainty by choosing a familiar rather than most efficient route; sitting in the same spot with full view of the teachers' room)

Our preliminary findings also demonstrate how autistic individuals engage in environmental crafting to facilitate high-quality relationships with colleagues—a non-environmental job resource. Steve volunteers at a *coaching center in an open-plan office* one half-day each week, where he actively seeks stimulation through social interaction. Steve's workspace is centrally located—in the middle of the hall right beside the staircase—providing frequent opportunities to observe others as they pass by. He deliberately uses the built work environment to facilitate engagement: for example, he sends print commands to the upstairs printer or places a coffee pot on his desk to create moments of social contact. These environmental crafting strategies highlight how Steve adapts his workspace to support interactions at work (Nguyen et al., 2025).

Approach demands crafting includes strategies autistic individuals use to address hindering demands, especially those related to the indoor environmental aspects (e.g., sunlight and lighting, acoustics, temperature) and presence of others in the workplace. Multiple autistic participants described how they manage indoor environmental discomfort and sensory stimuli by using personal items or by adjusting the workspace (individually or together):

- *Environmental crafting for light(ing)*: For instance, Sabine is sensitive to intense light sources and is bothered by the lights in *school corridors* that turn on automatically. Therefore, she always has her sunglasses with her to protect herself from bright lighting (Denys, 2024). Laura,

an autistic participant working in an *IT-related office* describes how she, together with her colleagues, removed some of the lights from the ceiling to create dimmer conditions, which suit her better. Maxim, an autistic participant who shares the *office* with Laura, describes himself as 'picky' about the light quality and prefers 'a lot of light in the office'. Despite the seemingly different needs, Maxim acknowledges that the amount of light in the office is satisfactory. Their workplace allows for light adjustments by e.g., lowering the blinds to avoid too much glare. Similarly, Steve uses vertical blinds to manage excessive sunlight in his *home office* (Nguyen et al., 2025).

- *Environmental crafting for workplace sounds and noise*: Use of headphones or earplugs as a strategy to limit the workplace sounds is common for several autistic participants (e.g., Emma, Pinky, and Sabine). Although Lucas finds the frequent movement of people in an *open office* environment distracting, he prefers not to use the headphones for the fear of missing out. Yet, he emphasizes how the whole day 'filtering of the sounds' costs all energy and often results in headaches at the end of the day. In this case, it may be that environmental crafting as behavior is purposely not employed to avoid losing other relevant job aspects like social relationships. While working at her desk in her *home office*, Sophie occasionally leaves the window open to let in fresh air. She is not really bothered by the relatively predictable street noise, mainly from cars. However, when there was a construction site close to her house whose sounds she found less predictable, Sophie preferred using earplugs or playing music she knows (Denys, 2024).
- *Environmental crafting for multiple sensory qualities*: In Emma's teacher's room, a significant portion of her shelf, which every teacher has for storing their work materials, is filled with items helping her to manage sensory stimuli (a sweater, various snacks, and earplugs). These items are crucial for maintaining her focus and preventing distractions while she works (Denys, 2024).
- *Environmental crafting as finding opportunities to retreat*: Hasse appreciates the variety of *retreat spaces* within one building: secluded corners and different rooms offering withdrawal opportunities. Wout values "pocket spaces" located near central areas, providing respite from demanding environments. When such spaces are unavailable, some individuals may use (wheelchair-accessible) restrooms or stairwells as last resort to withdraw from overstimulation.

Our preliminary findings also show how autistic people learn to manage indoor environmental demands such as noise for others too, thanks to their own experiences. For example, Sabine who works as a *high school* teacher, brings earplugs for students who are easily overstimulated and places them towards a white wall. Sabine is well aware of the necessity to create quiet moments and quiet places for both the students and teachers (autistic or not) (Denys, 2024). Additionally, interviews with autistic participants' allies in the workplace (available so far only in substudy 1) highlight the important role that others can play in approach demands crafting. In the case of Pinky's volunteering job, her working group has experimented with different meeting rooms to better accommodate the needs of autistic members, thanks to the approach demands crafting by the working group's chairperson (Nguyen et al., 2025).

Avoidance demands crafting encompasses environmental crafting strategies autistic individuals use to avoid hindering demands. Two types of strategies stand out: avoiding spaces, by choosing when (not) to work in a space, or avoiding it altogether, and minimizing unpredictability through preparation and by choosing familiar spaces:

- *Avoiding spaces as environmental crafting*: During summer Laura prefers working from home to avoid too hot conditions in her *office*, situated in a non-renovated building. In *adult education*, Emma and her co-workers have to share the cafeteria space with the students. Because of this, she eats alone in an empty classroom or in front of her desk in the teacher's

room to rest during lunchtime. Additionally, the campus where Emma works has adopted a *flexible desk system in the teacher's room* with a schedule where each employee can indicate their preferred hours and days for desk usage. This reservation system gives Emma more peace knowing when she can sit there during working hours without being disturbed—even though she still does not make a reservation as it also depends on who is in the room. Similarly, Sabine tends to use the 'quiet room'—a space where teachers can work outside their teaching hours—only later in the day, when it is nearly empty (Denys, 2024). In turn, Pinky is sensitive to unexpected sensory qualities: she is significantly affected by smells—a damp, moldy odor once deterred her from returning to a workplace, and she also avoids Dyson hand dryers due to their unbearable noise (Nguyen et al., 2025).

- *Minimizing unpredictability through preparation and by choosing familiar spaces:* For Pinky, *commuting to work* consumes time and energy she needs for work-related activities; she prepares extensively by e.g., conducting a test run to ensure she can arrive to work well. Her example highlights that spatial aspects related to work experience extend beyond the physical workplace (Nguyen et al., 2025). Similarly, Helena investigates new destinations online beforehand to assess their accessibility and pinpoint the exact location of entrances. Any discrepancy between her expectations and the actual situation may trigger a panic response. In the absence of clear signage, Hasse mentioned creating hand-drawn sketches to help navigate spaces. Thomas and Pieter opt for familiar paths to minimize uncertainty and reduce cognitive load, rather than taking the most efficient route. Carefully choosing where to sit may also be a form of avoidance demands crafting: in the *teacher's room*, Bart always sits in the same spot, with no one behind him and keeping both sides clear, allowing him a full view of the room.

DISCUSSION

This paper contributes to the growing literature on ED-R and job crafting models (Roskams & Haynes, 2021; Tims et al., 2022) and to the literature on lived experiences of autistic people by offering a nuanced perspective on how autistic individuals manage their working conditions across a variety of workplace contexts and employment types. By combining four substudies and mapping environmental crafting examples therein, our preliminary findings illuminate the different ways in which autistic people engage in environmental crafting—not only to reduce discomfort but also to enhance work motivation.

Existing scholarship on physical workplace accommodations for autistic individuals has predominantly emphasized the need for addressing sensory-related demands (Khalifa et al., 2020; Weber et al., 2022), which primarily compensate for the hindering workplace aspects. Our analysis expands this perspective by exemplifying that autistic people engage in a range of environmental crafting strategies that include both approach and avoidance behaviors. Accordingly, we see the potential of refining the environmental crafting concept within the ED-R model (Roskams & Haynes, 2021) by distinguishing between *approach-oriented* and *avoidance-oriented* forms of environmental crafting—based on the hierarchical job crafting model (Zhang & Parker, 2019). For example, we have found that autistic participants employ both approach-demands *and* avoidance-demands crafting: the first involves dealing with indoor environmental discomfort through individual and shared adaptive strategies (e.g., using sunglasses or removing lights from the ceiling to create dimmer conditions), whereas the second includes avoiding spaces (e.g., choosing when and where to work). The latter in particular highlights how autistic participants engaged in highly deliberate and effortful planning to avoid hindering demands, which offers valuable empirical contributions to the ongoing debate over the status of avoidance crafting as a form of proactive behavior (Zhang & Parker, 2019). These differentiated forms of engagement suggest that environmental crafting for autistic people is not merely about avoiding overstimulation or withdrawing but a conscious adaptation of one's work environment.

Our preliminary findings also reveal that environmental crafting can function as approach-resource crafting by creating job resources like a comfortable place to work. Moreover, environmental crafting strategies can enable other forms of job crafting, such as nurturing social relationships (e.g., example of Steve's coffee pot to engage socially). This suggests that the built work environment may play a role in job crafting more broadly—a possibility that merits further exploration.

A further insight is the emerging role of allies in the workplace in enabling environmental crafting. On the one hand, we learned that autistic people show resourcefulness by using their own experiences of autism to adapt the work environment not only for themselves but for others as well (autistic and non-autistic others). On the other hand, allies in the workplace such as co-workers or managers can play a significant role in environmental crafting for autistic individuals by for instance, experimenting with the use of different spaces and proactively considering possible accommodations (as a form of approach-resources and approach-demands crafting). In this process, the (non)disclosure status of autism in the workplace may influence the extent of allies' crafting; in the data we have collected so far, the allies were well aware of the participants' autism. Overall, this resonates with recent interest in collaborative or team crafting as an underexplored area in job crafting research (Tims et al., 2022).

This points toward some of the limitations of the present paper. As the research is ongoing, the presented analysis is based only on a subset of the data we plan to collect—including interviews with more workplace allies as secondary participants. For this reason, we consider our findings preliminary at this moment in the project; this may also explain why we were able to identify three out of four job crafting types (except avoidance-resources crafting). Additionally, our initial analysis suggests possible links between the flexibility of environmental adaptations—both spatially and organizationally—in workplace contexts such as a home office, or in office spaces where allies can actively participate in environmental crafting. However, with the current dataset, we are cautious in drawing conclusions about the distribution of different crafting types related to the workplace context.

Nevertheless, our preliminary findings have meaningful practical implications for different stakeholders in the workplace such as autistic people's co-workers, managers, workplace designers, and facility managers. A nuanced understanding of how autistic individuals manage their working conditions—through different forms of approach/avoidance environmental crafting—provides a wider range of support options. Importantly, it reveals how autistic people engage in environmental crafting at different scales or 'layers' of the workplace as seen in relation to 'shearing layers' (Brand, 1995). In contrast to dominant focus of the existing literature on enabling personalized workstations and flexible interior design, our analysis suggests that environmental crafting also happens at the level of the 'site' through commute and preparation to deal with unpredictability and 'services' through time of use (as forms of avoidance-demands crafting). Therefore, these findings call for considering autistic people's agency and contribution to workplace accommodations across scales and time.

CONCLUSIONS

This paper explored how autistic individuals engage in environmental crafting to manage their working conditions and align them with their needs. By combining insights from the Environmental Demands-Resources model and the hierarchical job crafting model, we used this theoretical framework as a sensitizing background to gain a more nuanced understanding of different forms of environmental crafting across a variety of workplace contexts (office, home office, school, university buildings). Our preliminary findings have shown that autistic individuals actively craft their work environments through both approach and avoidance-oriented ways. Specifically, (1) *approach-resources crafting* entails creating comfortable places to work—for oneself as well as for others; (2) *approach-demands crafting* relates to addressing hindering demands, especially those related to the indoor environmental aspects and presence of others in the workplace; and (3) *avoidance-demands crafting* is reflected in strategies like avoiding spaces and minimizing unpredictability through preparation and choosing familiar spaces. Our findings highlight that autistic people use their built work environment not only to mitigate discomfort but to enhance environmental and other job

resources, such as social relationships. While our analysis is based on a dataset that is currently expanding as the research project is ongoing, our preliminary results show potential in refining the environmental crafting concept within the ED-R model by distinguishing between *approach-oriented* and *avoidance-oriented* forms of environmental crafting. As next research steps, we will refine our analysis by considering how chosen environmental crafting strategies may depend on the workplace context and autism (non)disclosure as well as investigate whether these strategies identified by autistic individuals are relevant for other neurodivergent workers. In the case of autistic people, developing such a nuanced view on their agency and contribution to workplace accommodations may help broaden the range of support options and thus have meaningful practical implications for different stakeholders in the workplace such as autistic people's co-workers, managers, workplace designers, and facility managers.

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AI DECLARATION

Generative AI tools (ChatGPT, OpenAI) were used to support the development of this manuscript, specifically for brainstorming and refining the structure of the text based on author(s) own ideas. All content was critically reviewed and edited by the author(s) to ensure accuracy and originality.

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Facility Management Research

How Can Circular Office Renovation Contribute to Social Sustainability? A Norwegian Case Study

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ABSTRACT

Background and Aim. Social sustainability and circular principles in office renovation are increasingly relevant for reducing costs and increasing social value. While circular strategies often emphasize resource efficiency, this study focuses on the social impact, particularly on the tenant's well-being and the influence of tenant involvement in renovation processes.

Methods and Data. The study combines a brief literature review with a comparative case study of two office buildings in Trondheim, Norway. Semi-structured, in-depth interviews were conducted with the property owner and five tenants. Analysis used stepwise-deductive inductive (SDI) method for coding and a framework, called Integrated Social Sustainability Assessment (ISSA), originally developed for urban communities and neighbourhoods, justified and tested to measure social sustainability of the tenants at a building scale.

Results. The findings show that circular renovation practices and participatory design process enhance workplace flexibility and strengthen social values of tenants. Collaboration between property owners and tenants emerges as a critical factor in promoting circular principles and inclusive design, creating both social and economic value. The ISSA Building tool provided valuable insight identifying gaps between owner and tenant perspective on social sustainability.

Practical Implications. The study offers guidance for property owners on how to foster social sustainability in office renovation projects. Mapping social sustainability is highlighted as a practical means of identifying improvement areas.

Type of Paper. Full Research

KEYWORDS. circular renovation, office buildings, property owner, social sustainability, tenants

INTRODUCTION

The circular economy has the potential to transform the building industry into a more resource-efficient and environmentally friendly sector, while also reducing greenhouse gas emissions and opening new opportunities for economic growth (Papamichael et al., 2023). This requires interdisciplinary collaboration and a new approach to how we design, build, and manage buildings (Eberhardt et al., 2022).

Norwegian real estate investors and commercial building owners typically focus on rental income from commercial buildings, normally prioritizing long-term tenants (Hagen et al., 2018). Nevertheless, the practice of redesigning and renovating interior spaces before a new tenant enters remains widespread (Forsythe & Wilkinson, 2015). This tenant turnover-driven renovation results in significant building material waste even though building components and installations are reusable (Fini & Forsythe, 2020). This is a major challenge to achieve circularity in the built environment. This paper discusses the social impact, particularly social values of the tenant's and testing a tool for evaluating social sustainability at building level scale. The paper searches to answer the following research questions:

(RQ 1) How does the sustainable practice of the property owner affect the social sustainability of the tenants?

(RQ 2) How can social sustainability be measured at a building level?

This is done by analysing the findings of a multiple case study of two office buildings, aiming to understand the sustainable practice of the property owner and how this affects the social value of the tenants. Further, a novel framework for social sustainability at an urban scale is tested, to see if this framework also can be applied at a building level.

LITERATURE STUDY

Circularity in office buildings

In the building industry, the circular economy (CE) handles recycling waste, demounts building products that can be reused and maximize the time that the resources remain in circulation as well as creating and adding new value. For the building sector, there is a new aspiration to focus on reuse, repair, replace, upgrade, recycle and reduce central elements (Ellen MacArthur Foundation, 2019). To succeed with circularity projects there is a need for good planning competences and business models that promote collaboration (Hart et al., 2019 and Ghalandar & Lindkvist, 2023).

Measures may include extending the building's lifespan, optimizing resource use through functionality and the sharing economy, and ensuring flexible solutions that can adapt to new needs. It also involves considering local value creation and the use of locally sourced materials, utilizing synergies between buildings, planning for easy disassembly, and facilitating efficient material recycling (DFØ, 2022).

Several studies that looked at circular practices of reuse in Scandinavia, highlights the need of knowledge sharing of promoting circular principles among the stakeholders, particularly stakeholders that can influence the property owners to start rethinking the reuse of building products when renovating interior spaces of office buildings (Støre-Valen 2024, Fufa et al., 2023, Gerhardsson et al., 2020 and Nordby, 2019). Even though a more circular building industry is both politically prioritized and increasing demand in the market, the practical implementation of circular principles is still challenging (DFØ, 2022). The literature review report following barriers:

- *Cultural and Knowledge barriers* – Low levels of knowledge and awareness and hesitant company culture (Fufa et al., 2023, Gerhardsson et al., 2020, Kirchherr et al., 2018)
- *Economic barriers* – circular materials and solutions are not cost-effective and more time-consuming to implement than traditional alternatives (Fufa et al., 2023)
- *Market – Availability of reused products* – Takes collaboration to find available products or donor buildings that can supply the needed building products at the time of need (Støre-Valen, 2024)
- *Logistic and structural barriers* (Fufa et al., 2023)
- *Regulations and documentation requirement* – current regulations are tailored new materials, that makes the documentation process for reused building products both time-consuming and complex for suppliers (Fufa et al., 2023 and Nordby, 2019).

Social sustainability and the contribution between the property owner and users

Social sustainability is one of the pillars of sustainability. What social sustainability is in business, can be explained as community well-being, equity and resilience, involving inclusive opportunities and addressing inequalities as well as supporting people in developing their solutions and improving their social environment (Sustainability Success, 2022).

A property owner of office buildings will focus on developing a long-term relationship with the tenants that fosters user satisfaction and well-being. User satisfaction in work environments can be

classification of physical and psychological factors as physical comfort, functional and psychological needs (Kwon et al., 2019).

A conceptual model shown in Figure 1, visualizes the contribution between sustainable building renovation and social sustainability, as well as listing some of the main effects of the contribution between the property owner and the users. In this study, social sustainability is seen as (a) social needs related to do work related activities that fosters well-being and user satisfaction, health and safety, social cohesion and contribute to belonging and cultural value and (b) physical facilities that satisfy the user needs in a way that contributes to social values.

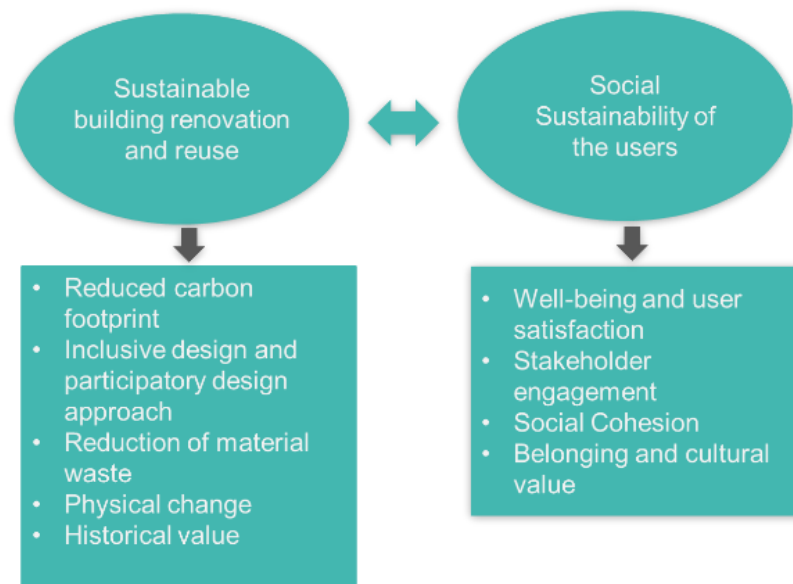


Figure 1 The contribution between property owners sustainable building renovation and circular practises versus social sustainability of the users. Source: Authors' own work

What contributes to social sustainability and social values in office buildings?

There are several different types of spatial office layouts, such as cellular offices, team offices, open-space offices, activity-based workplaces, and home offices. The choice of office design should be adapted to the organization's needs, work processes, and the employee's needs (Forooraghi et al., 2023).

The goal of the property owner is to make the building functional throughout its entire life cycle, which requires that it is adaptable and can be reshaped according to new demands and usage patterns. As organizational needs evolve and tenants are replaced, flexible spaces become an advantage. The trends of using open space offices with available silent zones has also entered Norwegian office workers and this change challenges the property owner to offer modern facilities with sustainable practices.

Modern office design favours either open space workplaces or hybrid configurations that combines open spaces with team offices. In contrast, earlier trends were dominated by traditional cellular offices. Within this shift, assessing social sustainability has become an important dimension in building evaluation, offering a valuable framework for examining how open-plan and hybrid office environments can contribute to social value (Stender & Walter, 2018).

Criteria for social sustainability

A novel tool for assessing social sustainability assessment, the Integrated Social Sustainability Assessment (ISSA) Tool, was developed by Norwegian researchers to evaluate the social sustainability of urban communities and neighbourhoods by combining input from experts and citizens (Akbarinejad et al., 2023). The ISSA tool is explored to see how it can be applied at a building level, to

assess how circular renovation of two office buildings contributes to social value to the tenants. While the ISSA tool was originally developed to evaluate social sustainability at the neighbourhood or urban scale, the ISSA Building framework was extracted from the ISSA tool to fit the context of buildings. This version focuses on internal building dynamics, such as workplace well-being, flexibility, environmental performance and user involvement, rather than broader spatial, economic or demographic factors. This version is called ISSA Building Framework and has been validated through both theoretical justification and empirical testing. Each indicator has been scored based on statements from tenants and the property owner, combined with research expertise in facilities management. Only the indicators that were relevant to be assessed at a building level were included as indicators applicable to the urban scale or broader demographic factors were excluded. Table 1 shows the indicators used in the ISSA Building Framework, without indicator A5, A6, C2, D5, D6, D10, F2 and F3.

Table 1 The ISSA Building Framework, based on the same indicators from the ISSA Framework (Akbarinejad et al., 2023) with categories and sub-categories and indicators of social sustainability

Category	Sub-Categories	Indicators	Code
Social Equity (A)	Equity of process	Access to information	A1
		Participation in decision-making	A2
		Formation of representative groups	A3
	Fair distribution	Facilities	A4
Environmental Awareness (B)	Environmental awareness and sensibility	Sustainable Materials	B1
		Clean and renewable energies	B2
		Water and waste management	B3
	Ecological literacy	Awareness of the physical environment	B4
		Knowledge of Social events	B5
		Ability to act against environmental problems	B6
Social Cohesion (C)	Social programs	Indoor and outdoor social gatherings	C1
	Social interaction	Design of a place that increases social interaction	C3
		Sense of belonging	C4
Health and Safety (D)	Safety measures	Feeling of safety	D1
		Relationships between neighbours	D2
		Street lighting at night	D3
		Physical resilience in case of hazards	D4
		Noise pollution	D7
		Ventilation	D8
		Lighting	D9
		Life satisfaction	D11
Accessibility Satisfaction (E)	and Ease of accessibility	Access to public transportation	E1
		Accessibility for disabled people	E3
Cultural value (F)	Satisfaction level local identity	Design of building	F1
		Post-occupancy evaluation	F4

METHODS AND DATA

This research is a comparative multiple case study, focusing on two office buildings newly renovated to meet the changing tenant needs. The aim was to examine how tenants and property owners relate to sustainable practices, with particular emphasis on the reuse potential of building materials and -products, what contributes to social values of the tenants and the decision-making process of the renovation project. As both buildings are owned by the same property owner, the study benefits from cross-case comparability while accounting for locational differences.

Data was collected through six semi-structured interviews of five with tenants and one with the property owner, who is responsible for sustainability strategies and tenant adaptation by the role of being facilities manager. All interviews were transcribed and analysed using the stepwise-deductive inductive (SDI) method where central topics were identified and used to compare experiences across the two cases. The SDI method is based on a systematic approach, where the analysis goes from raw data to concepts. It combines inductive processes, where findings are developed based on the empirical material, with deductive feedback loops to theory (Tjora, 2021). Table 4 presents the key topics that emerged from the interviews, highlighting how different aspects of building adaption influence the social sustainability experienced by tenants. To capture diverse perspectives, multiple tenants were interviewed in each case. This enabled a nuanced exploration of how tenants understand and experience social value, and how they collaborated with the property owner to meet evolving needs – such as increased space, flexible layouts and access to common areas including reception, meeting rooms, and canteens. The two cases, Case 1 and Case 2 are presented in Table 3, with key building and contextual information.

Table 3 Key building and contextual information for Case 1 and Case 2. Both cases are office buildings

Facts	Case 1	Case 2
Building year	2012	1985
No. of floors	4	11
Total net useable floor space (m2)	18 000 m2	17 181 m2
Type of office space	Tenant 1 Tenant 2 Tenant 3	Tenant 1 Tenant 2
Location	Non-central location	Non-central location
	urban	urban
Role of informants	Tenants and owner	Tenants and owner
Property owner	Private	Private
Standards of certification	Energy label B	No standard

Based on the findings of the interview we discuss what gives social value to the tenants. Further, we use the ISSA Building to score their perspective in each category (A to F) on a scale from 1 to 6. The property management role was also scored in the same way. Not all subcategories were relevant at a building level, so subcategories A5, A6, C2, D5, D6, D10, E2, F2 and F3 were not scored.

RESULTS

Measures that create a good working environment and impact the social sustainability are presented in Table 4. The topics are further elaborated after the table. The views of the property owner cover both cases.

Table 4 Topics that impact the social sustainability of the tenants and create good working environment, highlighted in the interviews from Case 1 and Case 2

Contribution to social sustainability	The property owner	Tenants from Case 1	Tenants from Case 2
Healthy indoor environment	Comfort, social zones, design of workspace	Access to meeting rooms and flexible zones	Improved ventilation and lighting. Flexible rooms and good indoor climate
Well-being	Comfortable and functional for the tenants	Comfort and individual adaption of workspace and office equipment	Comfort and healthy physical workspace
Workplace design	Flexible areas	Possibility to choose hybrid office space or silent space	Flexible zones and team-based layout
Noise	Noise mitigation action	Soundproofing and acoustic measures	Zoning and layout
Choice of colours and esthetical design	Timeless colours	Important for the company branding and cultural identity	Timeless colours and leftover paint from previous project
Reuse of building products	Paints	Ceiling panels	Interior paints
	Ceiling panels	Carpet chips	Kept existing elements when possible
	Carpet chips	Redesign of furniture's	
	Doors, steel studs, interior glass partitions, gypsum board	Doors	
Common space	Meeting room, lounge/reception,	Meeting room, lounge/reception	Meeting room, lounge,
	canteen, wardrobe, fitness rooms, parking spaces	canteen, wardrobe, fitness rooms, parking spaces	canteen, wardrobe, parking spaces
Environmental standard	Energy label B on Case 1		1 of 2 tenants uses ISO 14001
Involvement of tenants	Yes	Yes	Yes

Healthy indoor environment. The property owner focus on ventilation, lighting, and user well-being to create attractive workplaces that encourage tenant retention. Flexibility is a priority, and new projects involve careful planning of technical installations to facilitate future modifications. The tenants also view ventilation, lighting, and temperature as essential to a good working environment. However, tenant 3 highlighted difficulties with ventilation and temperature control in open-space offices and noted that there are diverse individual preferences. Several tenants also underpinned the need for functional, adaptable spaces that enable collaboration.

Well-being. The property owners' goal is that the facilities shall be perceived as comfortable and functional as the property owners want the tenants to thrive, aiming for a long-term relationship with the tenants. For the tenants the indoor temperature, adequate daylight and quiet surrounding is most relevant. Some of the tenants also highlight that well-being is relevant for the sense of belonging to the workplace.

Noise. The property owner adapts the facilities into flexible space and working zones while the tenants reported that noise is a challenge and has conducted several noise reduction actions. Of this reason involvement of the tenants in the decision-making process is essential.

Choice of colors and esthetical design. To create an overall impression of all the facilities, the property owner wants to use the same carpet tiles and recommends this to the tenants. The property owners

colour policy is to use a style that is not affected by new trends, using neutral colours. The tenants have a different approach to this topic. Some chooses neutral colours of the same reason while others choose colours that matches with the profile of the company.

“We have recently introduced a new logo, which was released late last year. This has brought certain challenges, as it requires adjustments to colours and related design elements.” -Tenant 3, Case 1.

Reuse of building products. The property owner keeps the surplus materials and products in a storage room in the basement, making these products easily accessible to tenants. However, there is no systematic approach in place for recording the quality or quantity of available materials and products, which primarily include items such as carpet tiles, glass partitions, insulation, steel studs and gypsum boards.

“When surplus materials from renovation projects are available, the property owner has occasionally stored them in the basement garage and subsequently notified all tenants in the building.” -Tenant 2, Case 2

The tenants report that the extent to which they focus on reuse varies. Some of the tenants choose to reuse and repair existing furniture's rather than buying new, while the most common products they reuse are doors or glass partitions (non-loading inner walls).

“Whenever we’ve reduced the office space here, we’ve tried to reuse as much as possible. For example, the glass walls and doors you see here now.” -Tenant 1, Case 1.

Common space. Common spaces that are highlighted as most valuable by the tenants is the reception area at the entrance of the building, designed as a welcoming area with chairs and green plants. The property owner also prepares common functions like wardrobes, meeting rooms, fitness room and parking space.

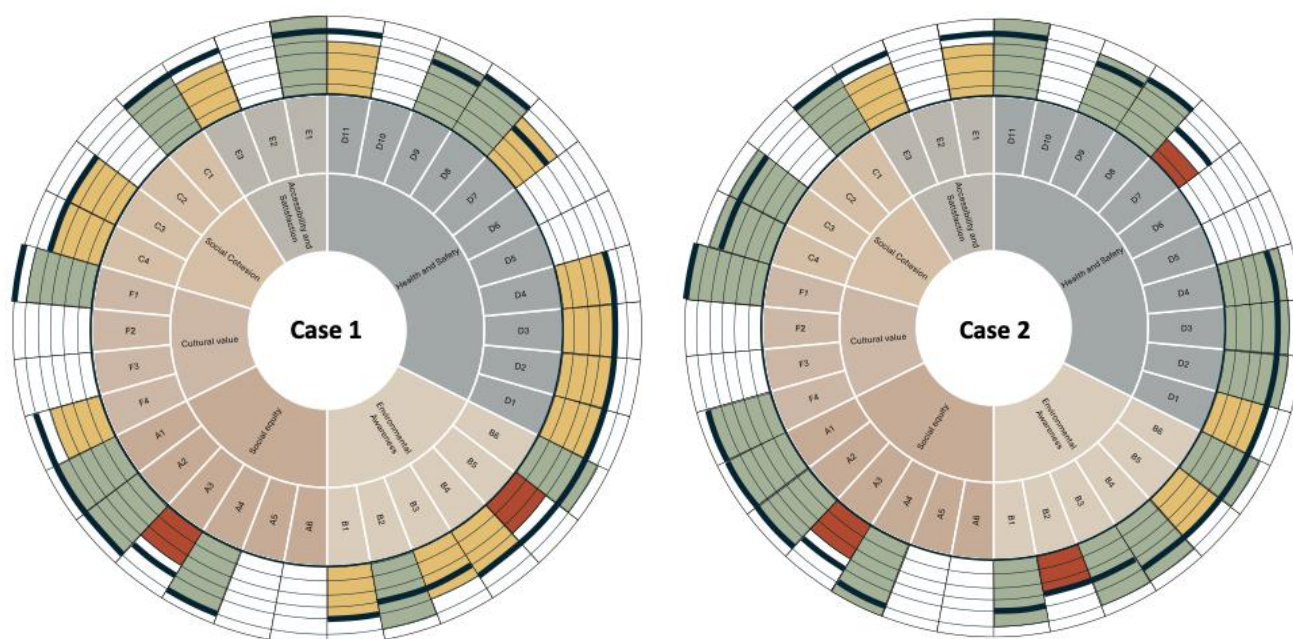


Figure 2 ISSA Building results for Case 2 - indicator A5, A6, C2, D5, D6, D10, E2, F2 and F3 – not scored

Environmental standard. The property owner is not certified or focuses on any environmental performance standard of the building. However, one of the buildings that are renovated has Energy

label B. One of the tenants says that they are ISO 14001 certified while the other tenants do not report any certification.

Involvement of tenants in decision-making process. The property owner involves the tenants in the renovation process at an early stage. This is confirmed by all the five tenants, both in renovation processes and adaptation of existing facilities, either in terms of changing plans, materials or functional solutions. They emphasize that there has been close collaboration in the planning phase to adapt the facilities to the needs of the business.

Type of sustainable practices. Property owner wants long term solution and aims for using building materials and -products with high quality. The tenants reuse their furniture's and sometimes building products, from a practical point of view. They also practice different approach for the colour design. Some choose neutral colours while others choose colours that promote the profile of their business. If the profile change, they repaint their facilities.

The ISSA Building evaluation of Case 1 and Case 2 are presented in Figure 2. The bold black line in both cases represents the property owner's perspective on social sustainability.

DISCUSSION

RQ1 How does the sustainable practice of the property owner affect the social sustainability of the tenants?

Organizations prioritizing sustainability can lead by example, influencing others and shifting cultural perceptions. The property owner's mindset often shapes tenants' attitudes. In the studied cases, owners had become more aware of sustainable practices over time, partly driven by tenants' demand for modern, healthy facilities that support wellbeing and productivity. Tenants also highlighted the value of welcoming common spaces, such as reception areas.

One of the tenants, that has been a tenant in the same facilities since 2009, reported that CE principles were not discussed during their initial move-in. However, in the latest renovation, the property owner actively promoted reuse of surplus materials like paint, doors, glass partitions, and carpet tiles and involved the tenants in the decision making. By storing these in the basement and encouraging tenants to use them freely for small adjustments, the owner demonstrated leadership in promoting circular practices. This is in line with Hart et al. (2019), that emphasize the importance of strong leadership and a clear vision in driving the adoption of CE practices.

According to the research literature, technological and regulatory developments alone are insufficient for advancing the circular economy (CE). It also requires new business models and changes in stakeholders' behaviours and attitudes (Hart et al., 2019). In this study, both property owners and tenants agreed on this, and emphasized the importance of business models that create mutual benefits and long-term collaboration.

In this study, the collaboration and involvement process of tenants in early phase planning and decision-making were proved beneficial, influencing their behaviours and attitudes as well as fostering identity and belonging.

RQ 2 How can social sustainability be measured at a building level?

Social Equity (A). There are no significant discrepancies among the property owner and the tenants, actors within category A. Regarding Formation of Representative Groups (A3), the property owner scores slightly higher (4) compared to Case 1 (3) and Case 2 (3). This is attributed to the property owner's emphasis on ongoing dialogue and regular interaction with tenants, which is presented as a key aspect. In terms of Facilities (A4), Case 1 (5) and the property owner (5) score marginally lower than Case 2 (6). In Case 1, the existence of underutilized or "dead" space is noted, indicating that spatial efficiency has not been fully optimized. In contrast, the findings from Case 2 suggest that tenants are generally satisfied with the available facilities.

Environmental Awareness (B). The category Environmental Awareness (B) varies greater in score compared to several of the other categories. For Clean and Renewable Energies (B2), scores differ significantly: Case 1 achieves a strong score (5), whereas Case 2 and the property owner score notably lower (3). This discrepancy is explained by Case 1's considerable emphasis on renewable solutions, such as the utilization of seawater for both heating and cooling. There is also variation in results for Water and Waste Management (B3). Case 2 receives a high score (5), following a stated emphasis on source separation of waste, particularly highlighted by a tenant who actively initiated and pushed the property owner to prioritize this basic measure. The property owner scores lower (3) on B3 due to criticism from tenants concerning waste management practices. Case 1 appears to demonstrate a moderate focus on this issue and has a score of 4. For Ability to Take Action Against Environmental Problems (B6), both Case 1 and Case 2 receive high scores (5). This reflects a growing awareness around sustainable practices and waste separation. All tenants also report a shift in attitudes over time, with increased awareness of circular solutions. The change in attitude typically emerged through direct experience and exposure to circular practices, rather than through formalized strategies.

Social Cohesion (C). The category Social Cohesion (C) is another category with consistently medium to good results for all stakeholders. When it comes to Indoor and outdoor social gatherings (C1), both cases and the property owner scores well (5). For Case 1, a social outdoor area has been established in the centre of the building that tenants can use. Case 2 does not have this but has a very inviting entrance area with a lounge, benches and green plants. For Design of a place that increases social interaction (C3) and Sense of belonging (C4), Case 2 (5) scores somewhat better than Case 1 and the property owner (4). Case 1 emphasizes office spaces with zones and open solutions, but social function is not highlighted. Case 2 is better organized for social interaction. A tenant for Case 2 emphasizes that the office landscape is deliberately designed to promote teamwork and collaboration zones.

Health and safety (D). Both cases and the property owner score mostly medium to good on all criteria in Health and safety (D). For the Health and Safety (D), Case 1 and the property owner score mainly the same, while Case 2 is one point higher. For Street lighting (D3), Case 2 scores low (2) due to a less well-lit outdoor area, while Case 1 has a better score.

Accessibility and Satisfaction (E). All the tenants and the property owner scored medium to good. For E1- Access to public transport, Case 1 has an immediate proximity to public transport and therefore scores very well (6). Case 2 has a somewhat greater distance to public transport and therefore scores 2 points lower (4). The property owner scores 5 on E1, but it is uncertain whether the property owner has a particular focus on the access to the public transport hub. For Accessibility for disabled people (E3), both cases score the same (4). This is somewhat uncertain as this was not asked for under the interviews. The score is therefore based on the authors evaluation of that the buildings are adapted for universal design through an easily accessible entrance and that both Case 1 and Case 2 have access to a lift. However, the property owner scores higher (5) on E3, as he wants to upkeep the buildings due to new regulations and focus on adaptation of the buildings.

Cultural value (F). Gives overall good results. For Design of building (F1), both Case 2 (6) and property owner (6) achieve full scores. This is because the respondents report a very high degree of involvement in the design process of the premises. Case 1 (5) has slightly lower satisfaction but still scores high on the scale, as both tenants in Case 2 emphasize a high degree of involvement. For Post-occupancy evaluation (F4), Case 2 (5) and the property owner (5) are rated somewhat higher than Case 1 (4). The reason for this is that tenants in Case 2 emphasize the post-occupancy evaluation of the premises more clearly than tenants in Case 1 do. Nevertheless, both cases score well on sub-category F4.

CONCLUSIONS

This study shows that the sustainable practice of the property owner affects the awareness of how the tenants can contribute to a circular practice. The tenant's wellbeing is the most important values in terms of long-term collaboration and satisfaction of the tenants. At the same time, effective

collaboration models, good communication and involvement practices as well as easy access to surplus materials also play a key role in enabling and shaping circular practices. In this research the property owner also work as a facility manager and is responsible for the wellbeing of the office users.

The ISSA Building framework demonstrates strong potential for assessing social sustainability in office environments. It offers a structured approach to evaluating how building characteristics and management practices influence tenants' social sustainability outcomes.

The application of the framework identified perceptual gaps between property owners and tenants. Overall, the ISSA Building framework provides knowledge of social sustainability practices and helping identify strengths and weaknesses in current practices, topics for improvements and being useful as a benchmarking tool between similar properties.

However, this study has certain limitations. The study focuses on perceptions rather than quantitative measurements and therefore depends on the participants personal opinions. In addition, the use of the ISSA Building Framework in this study is exploratory, and more research is needed to test its use in a wider range of buildings and different stakeholders.

FURTHER RESEARCH

This study demonstrates the potential of applying the ISSA framework at a building level, to evaluate how circular office renovations contribute to social sustainability. While promising, this approach requires further development to evolve into a robust and systematic assessment tool.

One fruitful direction for future research is the creation of a structured questionnaire grounded in the relevant ISSA indicator. In the present study, these indicators were evaluated through semi-structured interviews; however, a combined methodology—integrating structured questionnaires, expert evaluations, and interpretative interviews—may enhance the precision and applicability of the tool. Such a mixed-methods approach could serve as a practical screening instrument for social sustainability in the early stages of circular renovation projects.

Nevertheless, expert analysis will remain essential to ensure the credibility and contextual interpretation of the quantitative scores derived from the tool. To increase both the reliability and validity of the ISSA Building framework, future studies should apply it across a larger sample of tenants and properties, ideally encompassing diverse building types, ownership models, and geographic contexts.

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AI DECLARATION

AI assisted tools have been used in this paper to support language refinement, editing and clarity in improvements in the writing process.

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Assessing Social Sustainability in Buildings: Mapping Value Chain Actors Across the Lifecycle

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ABSTRACT

Background and Aim. Buildings are complex due to their long lifespans, numerous components, and diverse value chain actors. Recognized as a distinct stakeholder category within the social lifecycle assessment framework, these actors play a crucial role in evaluating buildings' social performance. Mapping value chain actors across the building lifecycle is essential for such assessments yet remains underexplored. This study addresses this gap by systematically identifying and mapping key actors in existing research.

Methods and Data. A scoping study is conducted to systematically map the value chain actors involved in the lifecycle of a building. The study adopts a methodical approach incorporating searches across the academic database Scopus. Its primary objective is to identify and characterize the key value chain actors and their roles within the building lifecycle.

Results. Findings indicate that the existing literature on value chain actors in the building lifecycle is highly fragmented. Actors are often confined to specific phases of the building lifecycle, rather than encompassing the entire process. This study has synthesized and produced a comprehensive mapping of value chain actors as represented in the extant literature.

Originality. Value chain actors in the building lifecycle are systematically mapped, focusing on the social dimension of sustainability and applying the social lifecycle framework to a complex and underrepresented area of study.

Practical Implications. Mapping of value chain actors across the building lifecycle can enable better collaboration, informed decisions, and more socially responsible practices in building management and construction.

Type of Paper. Full Research.

KEYWORDS. building management, life cycle assessment, social performance, social sustainability, value chain actors.

INTRODUCTION

Social impact can be described as awkward and confusing, as argued by Isgren & Longo (2024). However, neglecting social impact in sustainability assessments can lead to negative consequences for individuals, organizations, and broader social systems (Alomoto et al., 2022). Nevertheless, the social dimension has been under-theorized and oversimplified in sustainability research (Isgren & Longo, 2024). Often when the social dimension is included focus is on economic factors of social sustainability, such as employment (Mies & Gold, 2021; Padilla-Rivera et al., 2020). There is therefore a need for further research within social sustainability. Moreover, social sustainability is frequently overlooked in sustainability assessments of buildings (Lazar & Chithra, 2022) despite the real estate and construction sector significantly impacting all three dimensions of sustainability. Buildings are complex due to their long lifespans, numerous components, and diverse value chain actors. This can make sustainability assessment of buildings difficult.

However, social sustainability guidelines and standards exist, both general and specific for buildings and the construction industry. The United Kingdom Home Office recently published the Statutory

Guidance on Transparency in Supply Chains, where modern slavery is outlined as a large global issue (Home Office UK, 2025). The United Nations Environmental Programme has published guidelines for social lifecycle assessments (S-LCA) for products and organisations (UNEP, 2020). The S-LCA guidelines include stakeholder categories for which the social impact is to be assessed, including a stakeholder category for value chain actors (UNEP, 2021).

Further, the international standard Sustainability of construction works – Assessment of social performance of buildings – Calculation methodology (EN 16309:2014+A1:2014) was published in 2014 and is currently under review. The standard from 2014 only includes the use stage of the building, limited to accessibility, adaptability, health and comfort, impact on the neighbourhood, maintenance, and safety and security. Issues related to value chain actors in the way of sourcing materials and services is not yet deemed to be ready for standardisation but nevertheless mentioned in the standard as significant.

Considering the possible negative consequences for individuals, organizations and broader societal systems, the under-theorization and oversimplification of social sustainability in academic discourse, coupled with the lack of social assessments of buildings, further research is required in the realm of social sustainability throughout a building's lifecycle. However, as current standard for social assessment of buildings does not include value chain actors, despite their crucial role in evaluating buildings' social performance, it is currently difficult to undertake such a holistic assessment. Given the diversity and complexity of the value chain in a building's lifecycle, a systematic identification and mapping of these value chain actors is essential as a foundational step toward including them in standards for evaluating social sustainability of buildings. Mapping value chain actors across the building lifecycle is essential for such assessments but remains underexplored in current research.

This study aims to address this gap by systematically identifying and mapping the key value chain actors involved throughout a building's lifecycle in extant studies. A scoping study is conducted with the primary objective to identify and characterize the key value chain actors and their roles within the building lifecycle as present in extant literature. The paper first presents a brief summary of the S-LCA to provide insights into how the framework can be used to assess social sustainability in the value chain. This is followed by a comprehensive description of the methods and data employed in the study. The results are then presented, leading into a critical discussion and concluding remarks.

ASSESSING SOCIAL IMPACT IN THE VALUE CHAIN USING THE S-LCA FRAMEWORK

In the context of social sustainability, a range of assessment methods has been applied in the built environment context (e.g., Goel et al., 2020; Zuo et al., 2012). These studies often include a limited set of indicators. However, a broader S-LCA framework exists (UNEP, 2020). The S-LCA has nonetheless been sparingly applied in the built environment, with limited usage documented in works such as Liu & Qian (2019) and Lundgren (2023).

UNEP (2020) has released a framework for S-LCA assessments which include suggestions of social sustainability indicators grouped within sub-categories relating to six stakeholder categories (UNEP, 2020). The stakeholder categories are children, consumer/end-user, local community, value chain actors, society, and workers (UNEP, 2021). The indicators are used to collect generic data to identify high risk or opportunity areas within sub-categories. The high risk or opportunity areas are then evaluated using data from the specific case to provide information of the social sustainability of an organisation or product (UNEP, 2020). The stakeholder category value chain actors exclude consumers which are a separate stakeholder category. The subcategories for value chain actors are fair competition, promoting social responsibility, supplier relationships, respect for intellectual property rights, and wealth distribution (UNEP, 2020). The stakeholder category of value chain actors is not defined in the framework.

The product system of a building to be employed in lifecycle assessments is established in the standard for the sustainability of construction works and services (EN 15804) and Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method

(EN 15978). The product system including the lifecycle stages is presented in Figure 1. The included lifecycle stages are product stage (A1-A3), construction process (A4-A5), use stage (B1-B7), end of life (C1-C4), and benefits and loads beyond the system boundary (D).

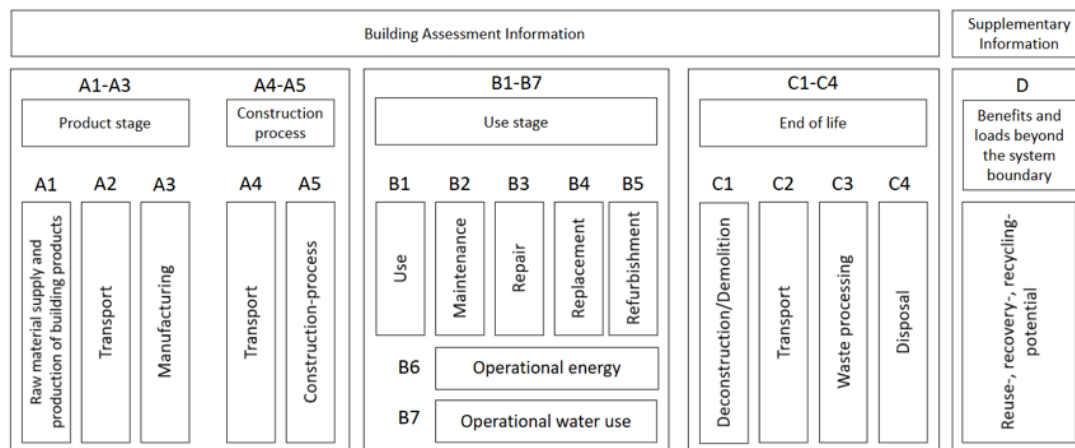


Figure 1 The product system of a building including the lifecycle stages (EN 15804 and EN 15978).

METHODS AND DATA

To evaluate the social sustainability of value chain actors, it is first essential to identify them. The primary objective of the study is therefore to identify and map the key value chain actors and their roles within the building lifecycle. The value chain in a building's lifecycle is multifaceted and intricate, and social sustainability remains insufficiently examined. Therefore, a scoping study approach has been employed. A scoping study is particularly useful when the research area is broad, complex, or underexplored (Levac et al., 2010). The research method is often used to map the breadth and depth of existing literature on a particular topic, identifying key concepts, gaps, and evidence. However, there is no single, widely accepted definition or purpose for a scoping study (Anderson et al., 2008).

In scoping studies, as opposed to systematic reviews, the quality of the included studies is not assessed (Levac et al., 2010). In this study it is not consider necessary to evaluate the quality of the included studies, as its primary objective is to identify and map value chain actors mentioned within the literature, regardless of whether they constitute the central focus of the studies. A mere mention of an actor is deemed sufficient for the purpose of this mapping exercise. The aim of this study is not to present a comprehensive overview of the current state of research but to systematically compile and organize value chain actors identified within extant research. The objective is to offer a holistic perspective on these actors by analysing extant scholarly literature. However, scoping studies necessitates a critical reinterpretation of the literature, something which is not prevalent in narrative and literature reviews (Levac et al., 2010). In order to effectively map the actors to the lifecycle stages of a building and to further characterize the actors it will at times be necessary to conduct such reinterpretation. Such reinterpretations have been made where a value chain actor has been mentioned but it is not clear from the document at what lifecycle stage the actor is involved and what value the actor adds. The author has then used previous knowledge and additional grey literature searches to establish the lifecycle stage which the actor participates in and if value is added.

The process in this study follows the steps of the Arksey and O'Malley framework, as presented by Levac et al. (2010). This framework has been refined and expanded upon from the original framework proposed by Arksey & O'Malley (2005), providing a robust and effective guide for conducting scoping studies. The steps included in the framework are: (1) defining the research question, (2) identifying relevant studies, (3) selecting studies, (4) charting the data, and (5) collating, summarizing, and reporting results. Levac et al. (2010) also suggests an optional consultation phase at the end of the process. This phase is employed to validate findings and provide additional insights through engaging

stakeholders or experts. This is excluded from this study as the focus is solely on a review of literature, however, is recommended to be conducted in future research.

Existing scoping studies have been criticized for a lack of methodological description or details. This is essential for comprehending the methods through which the study's findings were derived (Levac et al., 2010). The remainder of this section therefore provides a detailed account of the scoping process, presented in order of the steps of the Arksey and O'Malley framework.

Defining the research question

According to the Arksey and O'Malley framework the purpose and scope of the study should be clearly outlined. The research question should then be developed in consideration of the purpose and scope. Further, the research question should be sufficient in detail in order to establish an efficient search strategy (Levac et al., 2010). As previously mentioned, the primary objective of the study is to identify and map the key value chain actors within the building lifecycle. The objective is achieved by addressing the question of *which value chain actors are involved in the building lifecycle, and at what stages do they participate?* In order to answer the question, the term value chain actor first needs to be defined.

Value chain as a concept was introduced by Porter (1985). It describes the full range of activities required through the lifecycle of a product. In each part of the chain value should be added, including both value creation and value capture (Zamora, 2016). In business model theory value creation is where economic return is enabled through the activities of the organisation in relation to markets, revenue streams, and opportunities. Value capture refers to the revenue streams created, and costs incurred through engaging in these activities (Bocken et al., 2014). In the context of the built environment however, the term stakeholder is frequently used to refer to individuals or groups engaged in activities such as building projects. McGrath & Whitty (2017) define the roles of stakeholders as either invested, contributing, observing, or end-user. These stakeholders may or may not be considered value chain actors depending on if they add value as described in business model and value chain theory.

The S-LCA guidelines explicitly excludes consumers from the value chain as these are treated as a separate stakeholder group. The workers are also treated as an individual stakeholder group in the guidelines. Value chain actors will in this study include those organisations in a building's lifecycle which add value. This will include those defined in extant literature as value-chain, supply-chain, or stakeholder so long as value is considered to be added. Value added will be determined according to business model theory as an economic transaction, in terms of revenue or costs, has been enabled or occurred. The study will align with the S-LCA framework by UNEP (2020) and exclude workers, consumers, local community, and society as these are represented in separate stakeholder categories.

Identifying relevant studies

In this step a decision plan is developed for where to search, sources to include, terms to use, time span, and language (Levac et al., 2010). This study incorporates searches across an academic database and complimentary grey literature searches to further define life cycle stage and value added if this is not clear from the original source. No temporal limitations were imposed, and only open access sources were included. Only English sources were considered as attempts at translations may not be accurate and therefore misleading. The searches were conducted in Scopus. The following search terms were used: "BUILDINGS OR CONSTRUCTION AND STAKEHOLDER OR VALUE CHAIN ACTOR OR SUPPLY CHAIN ACTOR".

Searches were conducted within article title, abstract, and keywords. Further, the search included all document types to broaden the scope. The search was carried out in the spring of 2025.

Selecting studies

A total of 328 studies were elicited in the Scopus search. The titles, abstracts and keywords were then reviewed and those articles which were deemed likely to include value chain actors in the built environment context were further analysed (60). These were selected based on two selection criteria;

1) built environment context, and 2) likely to include mention of at least one value chain actor. Among the analysed articles, 41 explicitly mentioned at least one actor within the value chain in the context of the built environment. A significant number of articles were excluded as they did not satisfy the predefined inclusion criteria. Nonetheless, it was deemed essential to maintain a broad scope in the search terms due to the low number of articles containing the desired information. To avoid overlooking potentially relevant studies, it was decided to review a larger volume of articles, despite the inclusion of many that were irrelevant and therefore excluded from further analysis.

Charting the data

In this step the data is extracted and organized systematically (Levac et al., 2010). A data-charting form was developed and used to extract data from the included studies. The characterization was carried out based on year, country or region, value chain actors mentioned in the study, lifecycle stage, context, scale, and value added as described in the original source. The country or region of the study was determined firstly from the study methodology if a specific country or region was presented as the basis of the study, and secondly if no such mention existed the country of the affiliation of the first author was used. The scale was described as city, building, or product, or a combination of scales.

Collating, summarizing, and reporting results

In this final step the data is analysed and reported to identify patterns and themes (Levac et al., 2010). A qualitative content analysis was employed using a deductive approach where the lifecycle stages from the S-LCA standard was used as a basis. The process was iterative as the mapping of the value chain actors evolved throughout the process. Additionally, further lifecycle stages were added to accommodate the inclusion of value chain actors found in the extant studies. The findings from this step are presented in the results section. Firstly, a summary of the characterization results is presented. Followed by a mapping of the identified value chain actors to the building lifecycle stages.

RESULTS

The included studies were from various sources, however there were some journals and conference series which more than one study was published by, namely, Journal of Cleaner Production (5), IOP Conference Series: Earth and Environmental Science (3), Resources, Conservation and Recycling (2), International Journal of Construction Supply Chain Management (2), and Sustainability (2). The countries or regions were also fragmented with studies from all continents. Nevertheless, most prominent were the Nordics (15), the UK (5), Australia and New Zealand (4). Only one study was included from South America (Brazil) and notably none from North America.

The year of publication varied between 2016 and 2025. The years 2023 and 2024 has the greatest number of included studies (8 and 12 respectively), noting however that the study was carried out in early 2025 and therefore that year is incomplete. The number of studies included for each year is presented in Figure 2.

The product scale emerged as the most prevalent, with a frequency of 28 occurrences. This was subsequently followed by the building scale, recorded 18 times, and the city scale, which appeared once. It is important to note that some studies encompassed multiple scales, leading to instances of double counting in the overall analysis. These results are presented in Figure 3.

The studies were assigned to different lifecycle stages according to lifecycle assessment related standards EN 15804 and EN 15978. However, the design stage and planning could not be assigned to any existing stage and therefore a new stage was created named 'design stage' which contains both design and planning related actors. The need to create an additional stage was required as to not omit these actors or to assign them to stages where they did not belong. However, it can be argued that they can be involved in several of the lifecycle stages and affect even more stages.

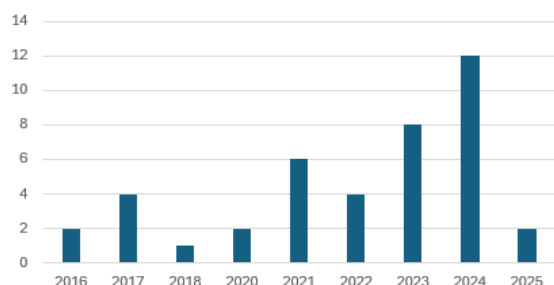


Figure 2 Number of studies per year. Source: Authors' own work

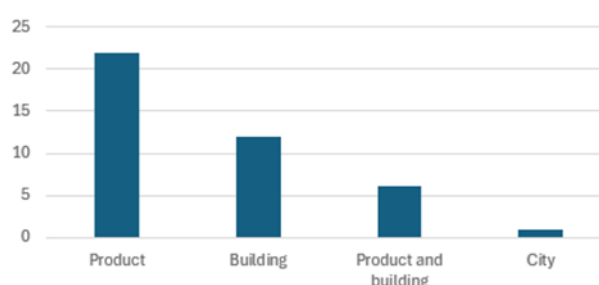


Figure 3 Studies included within each scale. Source: Authors' own work

The most mentioned lifecycle stage was the construction process (21), followed by the product stage (15). The mapping of value chain actors in this study is therefore likely to include a more comprehensive overview of the value chain actors in the construction phase of new buildings. Notably, the studies categorized under the use stage were predominantly associated with refurbishments, accounting for five instances. In contrast, only one study examined service provision, while another one focused on wastewater management. The end of life and benefits and loads beyond the system boundary were interconnected, as all studies addressing these lifecycle stages focused on the reuse and recycling of building materials. The number of studies assigned to each lifecycle stage of a building is presented in Figure 4.

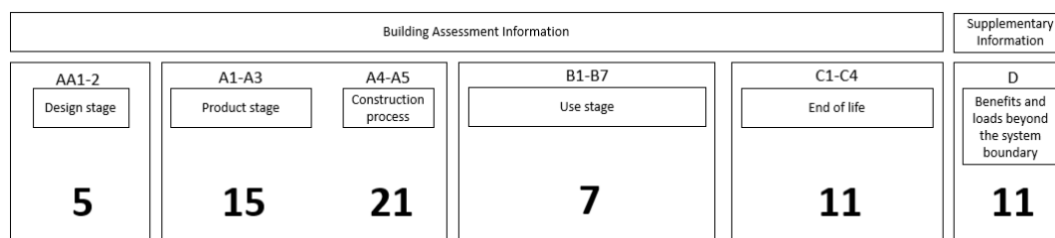


Figure 4 Number of studies assigned to each lifecycle stage of a building. Source: Authors' own work

The mapping of value chain actors in the included extant studies is presented in Figure 5. The client is inherently engaged in all stages of the lifecycle; however, the entity fulfilling this role may change over time. For instance, the developer responsible for the initial construction may differ from the eventual building owner, and ownership may transition multiple times throughout the building's lifespan. Other entities which impact the value of the building throughout the building life are research, authorities and governance, financiers, and insurance companies. However, in the case of research and authorities and governance it is not always possible to determine value added and will depend on the situation.

The design stage, introduced as an additional lifecycle phase to incorporate value chain actors that could not be classified within existing stages, encompasses professionals such as planning consultants, architects, design consultants, and engineers. Furthermore, this stage includes value chain actors specialising in environmental, climate, and energy consultancy, along with other consultants engaged in the design process.

In the lifecycle stage of raw material supply and production of building products (A1) producers of building materials are located. These include for example forestry owners growing timber for construction and mines extracting iron ore for production of steel. Further, processors and prefabricators using these materials are included, as well as the suppliers of the materials to manufacturers in the manufacturing stage. Additionally, marketers of building materials are included in the A1 stage. In the manufacturing stage (A3) designers and developers of construction products are included, as well as suppliers of the finished products. In the construction process (A5) the main contractor and sub-contractors are included, as well as any construction equipment suppliers. Project managers may be involved throughout the design stage, product stage and construction process. No

value chain actors for transport in these stages were identified in the included studies and therefore excluded from the mapping, however, is assumed to exist.

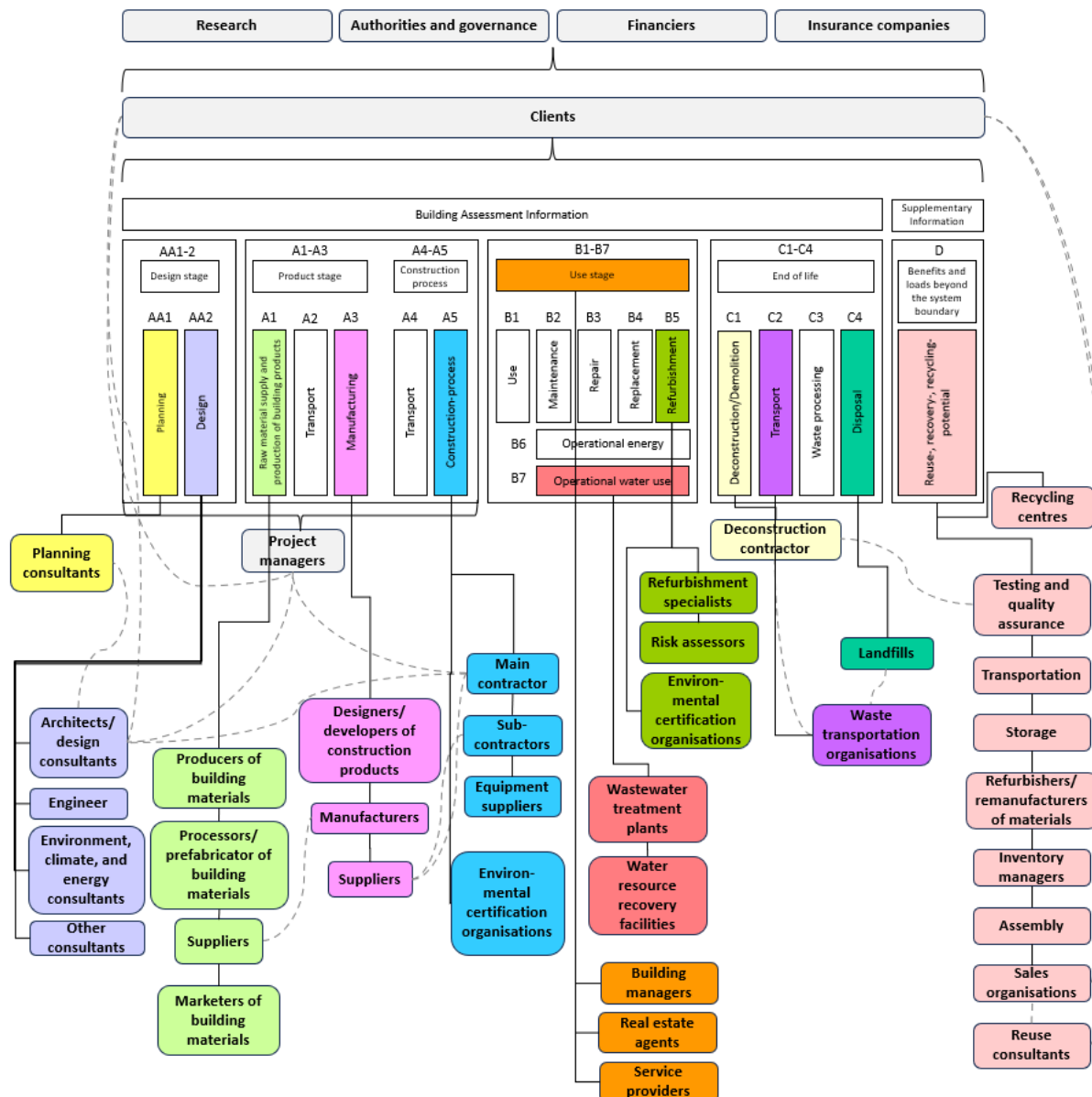


Figure 5 Mapping of value chain actors from included extant literature

Overarching the entire use stage are building managers. Furthermore, real estate agents and service providers may be involved at any stage during the use stage. Beyond these instances, few actors were identified within the use stage, aside from those associated with operational water use (B7) and refurbishment (B5). In B7, wastewater treatment plants and water resource recovery facilities were recognised as key entities. In B5, refurbishment specialists and risk assessors were identified, along with environmental certification organisations. No actors were identified for use (B1), maintenance (B2), repair (B3), replacement (B4), and operational energy (B6). However, the building managers may be seen as actors in these stages.

In the end-of-life stage the deconstruction contractor was identified for the deconstruction or demolition of the building (C1). Waste transportation organisations were identified for the transport stage (C2) to landfills in disposal (C4). The most value chain actors were identified in benefits and loads

beyond the system boundary stage (D). This process is intrinsically linked to the end-of-life stage, as materials and products that would otherwise reach the end of their functional lifespan are instead repurposed through reuse, recovery, and recycling. In this stage actors were identified which assumes materials either go to recycling centres or to actors for reuse. No recovery actors were identified. The reuse stage encompassed the highest number of identified actors, including those specialising in testing and quality assurance, transportation, storage, refurbishers and remanufacturers of materials, inventory managers, assembly, sales organisations, and reuse consultants. No actors were identified for waste processing (C3), however, some actors included in stage D can be considered as waste processors where waste is transformed into a valuable resource through processes such as reuse, recovery, and recycling.

In many instances it is possible for a value chain actor to be involved in different lifecycle stages and connect to other value chain actors in differing ways depending on e.g., contractual agreements. For example, the architects may be involved from the client side from the beginning if it is a traditional design-bid-build contract or through the main contractor if it is a turnkey contract. Additionally, the environmental certification organisations can be engaged by the client or the main contractor depending on contractual obligations.

DISCUSSION

This study aimed to systematically identify and map the key value chain actors involved throughout a building's lifecycle in extant studies. Several value chain actors were identified; however, some aspects of the lifecycle were not as prominent in the literature as others. Notably, few value chain actors were identified in the use phase. Considering the many sub-stages within the use stage and the duration of the phase compared to other stages there were fewer value chain actors identified than expected. The identified actors in the use stage were confined to refurbishment and operational water, as well as some spanning the whole phase, such as building managers and service providers. This highlights the need for further work in identifying value chain actors in the use phase, such as facility managers.

The value chain seems to end at the end of the construction phase in the extant literature and then start back up again at the end of life. The end of life as it relates to benefits and loads beyond the system boundary was particularly prominent if material was to be reused. This can be a result of a research trend towards a focus on material reuse, where the importance of the value chain has been highlighted (Dunant et al., 2017). Although this can be considered a positive trend, it is still essential to identify further value chain actors in the end-of-life phase.

Further, it can be noted that the construction of a new building, the use phase, and the end of life seem to be considered as separate value chains in the literature. Often a study would only address one of the phases, such as Celentano & Habert (2021) examining the construction process and Riuttala et al. (2024) addressing benefits and loads beyond the system boundary. Within the use stage it was also prominent that each sub-stage was considered its own value chain with few actors identified in each such chain. Furthermore, the specific roles and responsibilities of building managers and service providers were not explicitly defined, and findings suggest that soft services within facility management are largely absent from existing literature on value chains. Adopting a more comprehensive perspective on the value chain during the use stage may facilitate enhanced collaboration among value chain actors within this phase. Furthermore, a rigorous assessment of the social sustainability of value chain actors in the use stage necessitates the prior identification of relevant actors and an understanding of their interconnections.

Identifying and mapping value chain actors is a fundamental prerequisite for assessing social sustainability. By identifying and mapping the value chain actors involved throughout a building's lifecycle, as documented in existing literature, this study enhances opportunities for improved collaboration, data-driven decision-making, and the adoption of more socially responsible practices in building management and construction.

Limitations

Levac et al. (2010) recommend assembling a team of researchers when conducting scoping studies. This is however not included in the original framework by Arksey & O'Malley (2005). Levac et al. (2010) argue that a team is required for multidisciplinary and further recommend that a transparent and replicable process is employed. This study is, however, conducted by a single researcher with a multidisciplinary background, possessing extensive familiarity with various aspects of the built environment and social sustainability. The process is described in detail to assure a transparent and replicable process.

Further, limited studies were found explicitly mentioning the actors involved in the value chain. Many studies on value chains in the built environment context simply generalised value chain actors. More value chain actors could have been identified if the search was to include all studies within the built environment context, however, the volume of studies would have been unmanageable. The search term was extended to include both "supply chain actor" and "stakeholder" in addition to "value chain actor" which will have increased the identification of stakeholders to a certain extent.

Possible bias may be noted in terms of region and lifecycle stages. The most prominent regions were the Nordics and the UK. Whether this is due to those regions being leaders in value chain research in the built environment or the searches were biased towards those regions is not possible to determine without expanding the searches further. Similar questions can arise regarding the construction and end of life stages being the most prominent.

CONCLUSIONS

Findings indicate that the existing literature on value chain actors in the building lifecycle is highly fragmented. Actors are often confined to specific phases of the building lifecycle, rather than encompassing the entire process. This study has synthesized and produced a comprehensive mapping of value chain actors as represented in the extant literature. Further research is required to address the gaps identified in the existing literature, particularly concerning the use stage and end of life, as well as transportation during the product stage and the construction process. A more comprehensive investigation into these areas would contribute to a fuller understanding of the value chain and its implications for social sustainability assessments. It is suggested that the final stage of the Arksey & O'Malley framework, as presented by Levac et al. (2010) is carried out in order to identify the actors currently missing from the mapping through a consultation phase with stakeholders and experts. This is expected to yield further value chain actors in the use stage, such as facility managers.

DATA AVAILABILITY STATEMENT

The datasets are not publicly available but are available from the corresponding author on reasonable request.

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Community-based Facility Management in an Urban Experiment Area: Case Svartlamon

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ABSTRACT

Background and Aim. This study examines how Community-based Facility Management (CbFM) supports socially sustainable placemaking in urban experiment areas. Focusing on the Five Self-Built Houses in Svartlamon, Trondheim, it explores how grassroots management of infrastructure and shared spaces fosters resilience, belonging, and stewardship, and what this implies for Urban FM.

Methods and Data. A qualitative case study approach was used, combining document and literature review, field observations, and semi-structured interviews with residents, architects, and municipal stakeholders. Data were analyzed thematically, with a focus on governance structures, maintenance practices, community relationships, and institutional tensions.

Results. The findings show that CbFM in Svartlamon enables decentralized governance, collective infrastructure care, and strong social cohesion. Residents engage in horizontal decision-making and share responsibility for building upkeep and communal spaces. The study also reveals tensions between community autonomy and formal regulatory systems, highlighting the need for more adaptive policy frameworks in experimental urban areas.

Originality. This paper operationalizes CbFM as Urban FM in a legally designated urban experiment (Svartlamon), identifying three transferable mechanisms (resident-led maintenance, horizontal co-governance, and negotiated regulatory flexibility) that link community practice to urban-scale resilience and infrastructure stewardship.

Practical Implications. The study offers FM professionals, urban planners, and policymakers' new perspectives on enabling CbFM through concrete measures such as formalising co-maintenance protocols (task rotation, tool libraries, small-repair budgets); adopting performance-based permitting to legitimise material reuse/DIY; and using a non-profit housing foundation as asset custodian for low-rent, resident-stewarded stock in experimental districts.

Type of Paper. Full Research

KEYWORDS. community-based facility management, co-creation, placemaking, social sustainability, urban experiment.

INTRODUCTION

As cities face mounting challenges such as social inequality, housing precarity, ecological degradation, and declining trust in institutions, there is a growing need to reimagine urban development and the systems that support everyday life. Traditionally, Facility Management (FM) has operated within corporate, institutional, and service-oriented frameworks, focusing on the technical maintenance of buildings and infrastructure (Alexander, 1994). However, these models have proven insufficient in addressing the broader social and cultural needs of diverse urban populations. In response, Community-based Facility Management (CbFM) has emerged as a promising approach that realigns FM practices with the goals of local empowerment, co-creation, and sustainable placemaking (Alexander & Brown, 2006). CbFM shifts the focus of FM from service delivery to service

participation, involving residents and stakeholders in the planning, operation, and stewardship of facilities. It promotes values such as inclusion, transparency, and collective responsibility, enabling communities to shape their environments according to local needs and identities. The approach builds on Patrick Geddes' enduring triad of "place, work, and folk" (Chabard, 2016), which remains central to sustainable urbanism and participatory governance today.

This paper explores the role of CbFM in a unique urban setting: Svartlamon, an officially recognized urban ecological experiment area in Trondheim, Norway. Known for its anti-capitalist principles and alternative planning frameworks, Svartlamon offers a legally protected space for resident-led development, self-governance, and ecological experimentation (Stenberg & Bryngelsson, 2022). Within this district, the Five Self-built Experimental Houses, constructed between 2010 and 2017, serve as a tangible expression of CbFM in practice. These dwellings were designed and constructed by future residents in collaboration with architects and students, outside the bounds of conventional real estate development. The project emphasizes autonomy, architectural experimentation, and community-driven maintenance as the core principles of CbFM and co-creation. This study addresses a clear gap: we have little empirical evidence on how CbFM actually operates in legally designated urban experiment areas, such as how resident-led maintenance, horizontal governance, and regulatory negotiation are organized in daily practice. Moreover, the operational links between CbFM and Urban FM remain under-specified, including which mechanisms are transferable to city-scale FM.

This study aims to examine how community-based facility management (CbFM) operates in Svartlamon's legally designated urban experiment—focusing on the Five Self-built Houses—to support socially sustainable placemaking and to identify transferable mechanisms for Urban FM. The study is guided by the following research questions (RQ1): *How does community-based facility management support resilience, belonging, and shared responsibility in self-organized urban districts?* and (RQ2): *What lessons does the Svartlamon experiment offer for future facility management practices, particularly in socially oriented and experimental urban settings?*

Through a qualitative case study approach combining literature review, field observation, and semi-structured interviews, this paper contributes to the discourse on Urban-scale Facility Management (Urban FM). It argues that integrating CbFM into FM theory and practice can foster more inclusive, adaptive, and resilient urban futures.

This article is a single-case, qualitative study situated in a legally designated urban experiment; findings are context-specific and may not generalize without caution. The dataset is cross-sectional and relatively small, so longitudinal dynamics and broader stakeholder perspectives remain underexplored.

LITERATURE STUDY

Community-based Facility Management (CbFM)

CbFM is an emerging approach that repositions facility management beyond technical service provision and cost efficiency toward a more inclusive, participatory, and socially embedded model. CbFM emphasizes community ownership, stakeholder collaboration, and long-term engagement with the physical, social, and cultural aspects of places (Alexander & Brown, 2006). It reflects a shift in FM thinking, from delivering services to communities to enabling services with and by communities. CbFM is defined as *"the processes by which all the stakeholders in a community work together, to plan, deliver, and maintain an enabling environment, within which the local economy can prosper, quality services can be delivered, and natural resources protected"* (Alexander & Brown, 2006). This aligns with a triple-bottom-line perspective (people, planet, profit), embedding social equity, environmental responsibility, and economic resilience into FM practices. Core elements include participatory governance, transparency, local employment, and empowerment, especially among marginalized communities. These principles resonate strongly with contemporary urban regeneration movements, which view FM as a tool for community development, co-creation, and social innovation. The integration of community agency into FM expands the discipline's role,

positioning it as a contributor to placemaking, resilience, and civic well-being (Putnam, 2000; Roberts, 2004).

Urban-scale Facility Management (Urban FM)

Urban-scale Facility Management (Urban FM) refers to the management of shared urban infrastructure, such as public buildings, open spaces, mobility systems, and utilities, at the urban or district level. It is increasingly recognized as a strategic function essential to urban resilience, particularly in contexts facing aging infrastructure, climate uncertainty, and socio-political fragmentation (Prabowo, 2024b; Temeljotov Salaj & Lindkvist, 2021).

Urban FM expands FM's traditional scope by integrating physical asset management with urban policy, community governance, and sustainability objectives (Pitt et al., 2009). This includes managing the interfaces between public and private actors, formal and informal systems, and top-down and bottom-up processes. CbFM is often nested within Urban FM frameworks (Prabowo et al., 2024), acting as a catalyst for participatory models of service delivery and infrastructure stewardship.

While Urban FM often operates within structured municipal frameworks, the growing trend of experimental urban areas, which are zones where policy, architecture, and social practices are intentionally tested, highlights the need for adaptive, people-centered facility management systems.

Svartlamon as an Urban Ecological Experiment Area

An urban experiment area is a real-world setting where cities purposefully test new socio-technical solutions and ways of governing—bringing public, private, and civic actors together to co-create, implement, and learn iteratively. These spaces blur the line between planning and practice, using pilots and “living lab” methods to trial alternatives for sustainability, climate action, and everyday urban services. They can open pathways for change while also surfacing questions about inclusion, power, and how experiments become part of long-term institutions (Evans & Karvonen, 2011; Bulkeley et al., 2019; Marvin et al., 2018). Svartlamon, located in Trondheim, Norway, is an officially designated urban ecological experiment area (Figure 1).



Figure 6 Triangular area of Svartlamon. Source: <https://trondheim2030.no/2016/05/11/hva-na-svartlamon/>

It represents a unique planning and legal category that allows for resident-led development and alternative forms of living (Prabowo, 2024a; Senior et al., 2021). It evolved from grassroots activism into

a formalized urban district where community autonomy is protected by law and supported by the municipality (Stenberg & Bryngelsson, 2022). Unlike conventional neighborhoods, Svartlamon's residents participate in collective decision-making processes about land use, building maintenance, social activities, and infrastructure development. This experimental governance model challenges conventional planning paradigms, introducing a flexible and adaptive urbanism rooted in participatory democracy (Boligstiftelse, 2025).

From a facility management perspective, Svartlamon exemplifies how long-term stewardship of urban assets can be co-produced through horizontal governance, self-organization, and community responsibility. The area functions as a living laboratory for sustainable urban development, blending environmental values with cultural and social experimentation.

The Five Self-Built Houses Project: CbFM, Co-creation, and Placemaking

The Five Self-Built Experimental Houses in Svartlamon were developed between 2010 and 2017 through a participatory process involving residents, architects, students, and public authorities (Figure 2). Unlike typical housing projects, these houses were designed and built by the future residents themselves, with minimal interference from traditional developers or contractors (Arkitekter, 2024; Stenberg & Bryngelsson, 2022). The project was initiated as a response to questions about affordability, sustainability, and architectural freedom. It was supported by local policy instruments and funding frameworks that enabled experimentation with building materials, self-construction techniques, and co-design methodologies. The architectural outcome is a diverse ensemble of houses, reflecting the individuality of residents while maintaining a shared community principles (Prabowo, 2024a).



Figure 7 The Five Self-Built Houses Project at Svartlamon. Source: <http://eksperimentboliger.no/>

The immediate project site is approximately 600 m² and comprises five houses built by five households. In the wider district, Svartlamon includes around 30 buildings with roughly 118 flats and an estimated population of about 250 residents. Tenure follows the area's non-market rental model: the self-built homes are not owned by the builders but rented from Svartlamon Boligstiftelse, a non-profit housing foundation that leases the land from the City of Trondheim. More broadly, many dwellings in Svartlamon are owned by the foundation or the municipality and let at low rents, with an emphasis on resident participation in upkeep and communal areas. This situates the initiative within a non-profit rental framework rather than private ownership, co-op, or conventional social housing.

From an FM lens, the Five Houses illustrate core principles of CbFM in action, which are (1) shared responsibility for infrastructure maintenance and long-term upkeep, (2) resident-led decision-making in both construction and post-occupancy management, and (3) placemaking through everyday social practices, material reuse, and collective care of common spaces. The project also embodies co-creation as a method for not only designing but managing urban space, where the boundaries between user, designer, and manager are intentionally blurred. In this sense, the Five Houses are not just buildings. They are platforms for social interaction, experimentation, and resilience.

METHODS AND DATA

This study aims to examine how community-based facility management (CbFM) contributes to socially sustainable placemaking in the context of an experimental urban area. The central objective is to understand how everyday practices of co-creation, maintenance, and governance are organized and sustained by residents in the Five Self-built Experimental Houses project within Svartlamon, Trondheim. Specifically, the analysis focuses on the ways in which infrastructure care, shared decision-making, and material experimentation reflect principles of CbFM and how these practices interact with the broader framework of Urban Facility Management (Urban FM).

To address the objective, this study employed a qualitative case study methodology to explore the role of community-based facility management (CbFM) in fostering socially sustainable placemaking within an experimental urban context. A case study approach is well-suited for investigating complex social phenomena within their real-world settings, particularly when the boundaries between context and subject are blurred (Yin, 2017). This research focuses on the unique context of Svartlamon, a self-governed neighborhood in Trondheim, Norway, which holds the official designation of an urban experiment area. Within Svartlamon, the Five Self-built Experimental Houses project was selected as a sub-case. This project is particularly relevant for examining CbFM in action, as it embodies co-creation, collective governance, and community-led maintenance of infrastructure.

Data collection involved three complementary methods. First, an extensive literature and document review was conducted. This included scholarly publications, municipal policy reports, architectural evaluations, and archival material related to Svartlamon and the Five Self-built Houses. Key resources included project documentation from Nøysom Arkitekter (Arkitekter, 2024) and public material available on online platforms. This review provided critical background on the project's inception, planning framework, and evolution, as well as conceptual grounding in the principles of CbFM and experimental housing.

Second, field observations were carried out during site visits in 2023 and 2024. These observations focused on both the physical and social environments of Svartlamon. Detailed field notes captured aspects such as the condition and use of shared facilities, evidence of ongoing maintenance by residents, informal signage, material reuse, and instances of community interaction. The observations served as a way to contextualize the built environment and verify the embeddedness of CbFM practices in everyday life. Third, a series of semi-structured interviews was conducted with individuals directly involved in the planning, construction, and ongoing life of the Five Self-built Houses. These interviews included residents of the experimental houses and a municipal planner familiar with Trondheim's housing innovation policies, and active members of Svartlamon's community governance structure. The interviews were designed to explore themes such as self-building experiences, collective decision-making, post-occupancy infrastructure management, regulatory interactions, and community values. Interviews were held in English, recorded with consent, transcribed verbatim, and anonymized to ensure confidentiality.

The collected data were analyzed through thematic coding (Braun & Clarke, 2006). Transcripts and field notes were coded inductively to identify recurring patterns and meaningful themes related to facility management practices, resident agency, and social dynamics. Coding was carried out using NVivo 15 software, which facilitated systematic analysis and the triangulation of insights across interviews, literature, and observation. The resulting themes were interpreted through the theoretical

lenses of CbFM and Urban-scale Facility Management to generate analytical insights that, while context-specific, hold potential relevance for broader urban FM practice.

RESULTS

The findings of this study reveal how Community-based Facility Management (CbFM) operates in the everyday life of Svartlamon and, in particular, how the Five Self-built Houses exemplify resident-led facility management, social cohesion, and adaptive placemaking. Through analysis of interviews, observations, and documentation, four major themes emerged: grassroots governance and decision-making, collective infrastructure maintenance, social cohesion and identity, and tensions with regulatory frameworks.

A central theme of facility management in Svartlamon is the role of grassroots governance and horizontal decision-making. The residents of the Five Self-built Houses engage in collective processes that range from construction planning to day-to-day decision-making about shared infrastructure. Instead of relying on formalized contracts or external FM providers, agreements among residents are made through consensus-driven dialogue. Meetings are informal but frequent, often taking place in shared kitchens, gardens, or community spaces. Participants emphasized that this governance structure fosters a strong sense of ownership and responsibility. One resident noted, “We don’t just live here, we run this place together. It’s not management from above, it’s our hands and our time.”

The second key theme concerns collective maintenance and long-term care of infrastructure. Facility upkeep is performed through informal division of tasks among residents, often based on skill, interest, or availability. While this approach lacks the standardized procedures typical of institutional FM, it proves effective in preserving buildings and shared areas due to the deep personal commitment of the residents. Tasks such as repairing drainage systems, repainting facades, and managing compost toilets are undertaken voluntarily. While some challenges arise in maintaining consistency, especially as residents change over time, the collective principles have sustained the project’s physical integrity for more than a decade after construction.

The findings underscore the role of CbFM in cultivating social cohesion and a sense of belonging. Residents repeatedly expressed pride in their contribution to the neighborhood and described their living environment not simply as a functional space but as a meaningful extension of themselves. This emotional attachment is reinforced through shared activities such as gardening, communal meals, and neighborhood celebrations. The process of building the houses together also forged strong interpersonal bonds, which continue to serve as the foundation for mutual support and conflict resolution. One interviewee reflected, *“Because we built these homes ourselves, we are emotionally invested in each other’s well-being, not just the walls.”*

The results point to ongoing tensions between community autonomy and formal regulations. While the municipality of Trondheim has supported Svartlamon’s experimental status, conflicts occasionally arise regarding building codes, safety standards, and long-term sustainability. Residents expressed concern over bureaucratic processes that can undermine the flexibility and experimental spirit of the neighborhood. In some cases, securing permits or funding for upgrades required navigating complex institutional systems not designed to accommodate self-managed communities. Participants valued the trust-based relationship with the city and highlighted the importance of legal recognition in protecting their autonomy.

The results also demonstrate that CbFM in Svartlamon extends far beyond technical maintenance. It operates as a socially embedded practice of collective care, placemaking, and negotiation, which are anchored in lived experience, mutual responsibility, and a commitment to alternative urban futures (see Table 1), which include maintenance of building envelopes, shared tool lending, repairs, seasonal care (e.g., gardening, snow clearance), and coordination with the housing foundation regarding larger technical issues. These activities reflect resident-led FM at the scale of both private and semi-public space.

Table 1 Summary of key themes and findings

Themes	Key Findings	Captured Quotes
Grassroots Governance and Decision-Making	Residents engage in horizontal, consensus-based governance without relying on external FM providers. Decisions are made collectively through informal meetings.	<i>"We don't just live here, we run this place together. It's not management from above, it's our hands and our time."</i>
Collective Maintenance and Infrastructure Care	Facilities are maintained informally among residents based on skills and interests, including plumbing, painting, and shared system repairs. This includes regular plenary meetings, working groups for specific tasks, and informal task rotation practices among residents.	Voluntary labor and shared responsibility sustain the buildings for more than a decade post-construction. Flexibility is prioritized over standardization.
Social Cohesion and Sense of Belonging	Strong emotional attachment to the place is developed through co-building and mutual support. Placemaking is integrated into daily life.	<i>"Because we built these homes ourselves, we are emotionally invested in each other's well-being, not just the walls."</i>
Tensions with Regulatory Frameworks	Conflicts arise between community autonomy and formal municipal regulations (e.g., permits, codes, funding). Legal recognition helps protect experimental governance.	The municipality supports the experimental zone, but traditional regulatory systems are not always flexible enough to accommodate self-managed communities.

The themes emerged consistently across interviews, observations, and supporting documents. Together, they illustrate how CbFM is embedded in the social and spatial fabric of Svartlamon, shaping both the physical upkeep of the Five Self-built Houses and the relationships among those who inhabit them. To provide a clearer overview of these key findings, the following table summarizes the core themes, their associated insights, and illustrative examples drawn directly from the fieldwork.

DISCUSSION

This discussion returns to our aim: to understand how CbFM in Svartlamon's urban experiment—centred on the Five Self-built Houses—supports socially sustainable placemaking and which mechanisms are transferable to Urban FM. In this paper, resilience refers to the capacity of the Svartlamon housing–community system to keep everyday functions going while adapting and learning under change—seen in practice through resident-led maintenance, horizontal decision-making, flexible use and materials, and the ability to negotiate regulatory demands without losing community cohesion. The findings of this study provide insight into how Community-based Facility Management (CbFM) operates as both a practical and social framework for managing shared urban environments. Through the lens of Svartlamon and the Five Self-built Houses project, the results demonstrate that CbFM is not simply a grassroots substitute for conventional facility services but a distinct and evolving model of placemaking, co-creation, and long-term sustainability. In what follows, each key theme is discussed in relation to existing literature, theoretical frameworks, and implications for the broader field of Urban Facility Management.

Grassroots Governance and Horizontal Decision-Making

One of the most prominent findings in this study is the centrality of informal, consensus-based decision-making in enabling resilient CbFM (Figure 3).

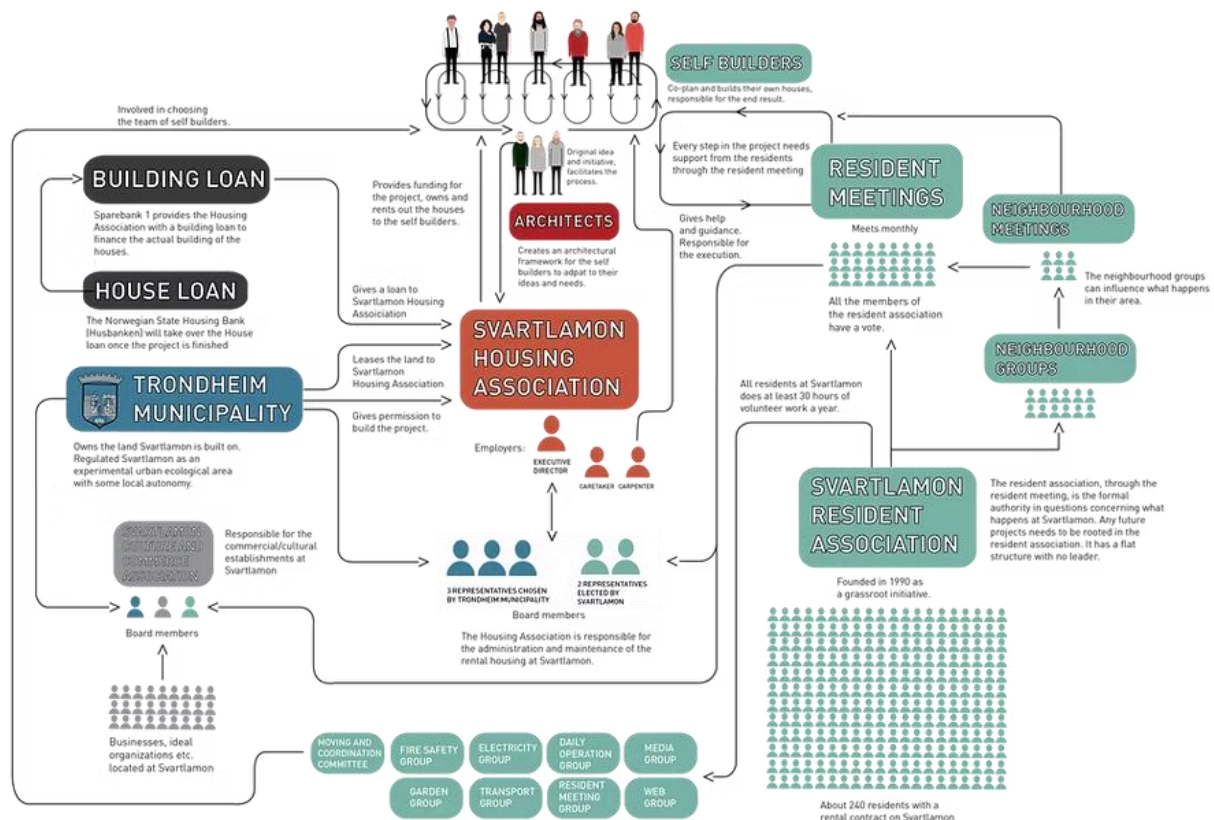


Figure 8 Organizational and participatory model of Svartlamon. Source: <http://eksperimentboliger.no/>

In contrast to hierarchical management models, residents in Svartlamon co-create governance structures that are flexible, dialogical, and embedded in everyday social life. This echoes Alexander and Brown's framing of CbFM as a vehicle for social inclusion, where facility-related decisions are seen not merely as technical tasks but as opportunities for democratic engagement and civic learning (Alexander & Brown, 2006). The participatory governance found in Svartlamon reflects a shift in FM from service provision to social co-production in which the literature study describes as a move from managing for people to managing with people (Alexander & Brown, 2006; Roberts, 2004; Temeljotov Salaj & Lindkvist, 2021). This has significant implications for how FM professionals are trained and positioned within urban development contexts, particularly in experimental or self-organized settings.

Collective Maintenance and Infrastructure Care

The informal division of labor and mutual care systems observed in the Five Self-built Houses challenge the notion that facility maintenance requires rigid protocols and top-down oversight. While such systems might be seen as fragile or unsustainable from a conventional FM perspective, in this case, they have proven remarkably resilient over time due to strong community ownership and localized knowledge. Maintenance here is not outsourced; it is lived and shared. This supports emerging theories in FM that advocate for user-integrated and adaptive maintenance regimes (Price, 2004), particularly in contexts where formal institutions may not be equipped to address small-scale, highly specific needs. However, this model also raises important questions about continuity, accountability, and the transfer of responsibility when residents change over time.

Social Cohesion and Sense of Belonging

Arguably, the most profound impact of CbFM observed in this study is its capacity to strengthen social cohesion and a sense of belonging. The emotional investment that residents have in their homes and neighborhood, largely due to their involvement in the construction and ongoing management

processes, aligns with the idea of FM as a facilitator of place attachment and community identity (Alexander & Brown, 2006; Putnam, 2000). In Svartlamon, especially the Five Self-built Houses project, buildings are not neutral assets but the product and expression of collective memory and shared labor. This further expands the scope of FM beyond operational efficiency, underscoring its potential to act as a foundation for social sustainability. The findings affirm that CbFM can foster not just physical upkeep but also social resilience, which is increasingly seen as a critical dimension of sustainable urbanism.

Tensions with Regulatory Frameworks

Despite the many benefits of community autonomy, the study also reveals important tensions with existing regulatory systems. While Trondheim's designation of Svartlamon as an urban experiment area provides a degree of legal protection, residents still face challenges in navigating formal permitting processes and meeting safety or technical standards. This tension highlights a persistent mismatch between the flexible, iterative nature of community-based practices and the rigid structures of conventional planning and building control, such as strict building codes, insulation requirements, and standard construction norms that limited material reuse or non-standard design solutions. These were negotiated through special exemptions from Trondheim Municipality as part of the area's experimental status. Internal disagreements also occasionally arise, especially around differing expectations or the capacity to contribute labor. These have generally been resolved informally but are acknowledged as an ongoing dynamic. The situation echoes broader critiques in FM and planning literature regarding the limitations of institutional systems in accommodating informal or emergent urban practices (Stenberg & Bryngelsson, 2022). For FM to be truly inclusive and context-sensitive, regulatory frameworks may need to evolve in parallel, becoming more adaptive and open to negotiated standards in experimental environments.

Scientific and Practical Implications

The study contributes to the growing body of knowledge on socially oriented FM by offering an empirical case that bridges the gap between grassroots experimentation and theoretical models of CbFM and Urban-scale FM. Svartlamon illustrates how community-driven facility management is not only feasible but desirable under the right conditions, producing outcomes that extend well beyond technical performance to include social, emotional, and ecological value. For practitioners, this suggests a need to reconceive FM as an enabling platform that supports autonomy, participation, and place-based decision-making rather than imposing uniform standards. It also points to the importance of integrating community engagement strategies into FM education and policy frameworks.

From a research perspective, the case of Svartlamon invites further exploration of how such models can be scaled, replicated, or adapted in different socio-political contexts. Other studies and perspectives are particularly needed to assess the durability of CbFM practices over time, especially as demographic shifts and generational transitions occur. Moreover, future work could benefit from comparative analysis between top-down and bottom-up FM systems in terms of both cost-effectiveness and social outcomes.

This study added empirical evidence that CbFM practices—resident-led maintenance, horizontal co-governance, and negotiated regulatory flexibility—function as neighbourhood-scale resilience mechanisms: they keep basic services running, enable low-cost adaptation when conditions change, and help retain practical know-how within the community. Framed this way, Svartlamon shows how social organisation and everyday FM routines can deliver resilience outcomes that Urban FM can translate into policy and practice.

CONCLUSIONS

This study set out to explore how Community-based Facility Management (CbFM) contributes to socially sustainable placemaking within the context of an experimental urban area. Using the Five Self-built Houses in Svartlamon, Trondheim, as a focal case, the research has demonstrated that CbFM

is not merely an alternative to conventional facility management, but a fundamentally different mode of urban stewardship, which is rooted in co-creation, shared responsibility, and grassroots governance.

The findings highlight how Svartlamon's horizontal decision-making processes, informal maintenance systems, and strong social cohesion enable a resilient, adaptive, and community-led approach to managing urban infrastructure. These practices are deeply embedded in the everyday lives of residents, blurring the lines between user, builder, and manager. The study shows that when residents are empowered to govern and maintain their own environments, the outcomes extend beyond physical upkeep to include social identity, trust, and collective pride. However, the study also identifies tensions between community autonomy and formal regulatory frameworks. These tensions underscore the need for more flexible and responsive institutional mechanisms that can accommodate alternative governance models, particularly in contexts of experimentation and grassroots innovation.

This research contributes to the evolving discourse on Urban-scale Facility Management by positioning CbFM as both a practical and theoretical advancement in the field. It calls for a broader recognition of FM not only as a technical profession but as a social practice that can support inclusive, sustainable, and resilient urban futures. As cities across the world seek to address challenges of inequality, climate adaptation, and civic disengagement, the lessons from Svartlamon point to the transformative potential of community-led facility management. Future research should investigate how CbFM models can be sustained over time and scaled to other urban contexts with different governance cultures. Comparative studies and longitudinal approaches could further illuminate the capacity of CbFM to shape more equitable and participatory forms of urban development.

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AI DECLARATION

The author acknowledges the use of artificial intelligence tools to support the writing process, specifically for paraphrasing and grammar checking. These tools were used solely to enhance clarity and language quality. All content, interpretations, and conclusions presented in this paper are the sole responsibility of the author. This disclosure aligns with the guidelines of the Committee on Publication Ethics (COPE) on the appropriate use of AI in scholarly publishing (<https://publicationethics.org/cope-position-statements/ai-author>).

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Unlocking Rehabilitation Potential: Financial Incentives and Social Motivation in the Norwegian Context

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ABSTRACT

Background and Aim. The building industry is a major source of energy use and greenhouse gas emissions in Norway, making rehabilitation a key measure to achieve climate targets. While rehabilitation offers clear environmental benefits, uncertainty remains about whether current subsidy schemes sufficiently incentivize large commercial projects and how heritage rehabilitation contributes to pride and social value within organizations and communities.

Methods and Data. The study applies a qualitative design based on twelve semi-structured interviews with thirteen decision-makers in Norwegian real estate companies. Participants were selected for their direct experience with rehabilitation projects. The interviews were written out, organized around both predefined and emerging themes, and analyzed to find recurring patterns and insights.

Results. Current subsidy schemes are perceived as inadequate due to low support levels, lack of transparency, and high administrative costs. Participants suggested improvements such as direct subsidies, tax-related incentives, and simplified application processes, stressing the need to include small-scale property owners. At the same time, strong social outcomes from heritage rehabilitation were reported, including organizational pride, community belonging, and reputational value, even when projects were financially unprofitable.

Originality. The study highlights how economic and social factors jointly influence rehabilitation decisions, showing that weak subsidies limit socially beneficial projects, while pride and legitimacy can motivate actors to rehabilitate despite financial losses.

Practical Implications. Findings highlight the need for predictable incentives and greater emphasis on social sustainability to advance rehabilitation and climate goals.

Type of Paper. Full Research

KEYWORDS. building rehabilitation, heritage buildings, Norwegian real estate, social sustainability, subsidy schemes

INTRODUCTION

The building industry is a central contributor to climate and energy challenges, accounting for roughly 40% of Norway's total energy use and 16% of national greenhouse gas (GHG) emissions (Energifakta Norge, 2024; Enova, 2023). Despite ambitious national climate targets, including a legally binding goal of cutting emissions by at least 55% by 2030 compared to 1990 levels, progress has been slow (Lov om endringer i klimaloven, 2023, § 3). By 2023, emissions had only decreased by 9.1%, and projections estimate that Norway will not reduce more than 26.3% of emissions by 2030 compared to 1990 levels (Larsen & Lønrusten, 2024).

In the building sector, energy use and emissions remain high. The government has committed to reducing electricity consumption by 10 TWh by 2030 compared to 2015 levels, yet current projections suggest a reduction of only 3.4 TWh (NOVAP, 2025; Boye, 2024).

The Norwegian Water Resources and Energy Directorate (NVE) considers the 10 TWh target technically achievable but warns that existing policy measures are insufficient to reach it (Hagemoen & Baardsen, 2024).

To address these challenges, Norway has incorporated the 2018 Energy Performance of Buildings Directive (EPBD) into the EEA Agreement, requiring a long-term renovation strategy for the least energy-efficient buildings (Energidepartementet, 2025). A revised EPBD, adopted in 2024 and under EEA review, sets stricter targets, requiring commercial buildings to reach energy class E by 2030 and D by 2033 (MonitorEE, 2024).

Norway has 4.34 million buildings, including 264,389 non-residential structures relevant to this study (SSB, 2025). Though less than 7% of the stock, commercial buildings consumed 30.2 TWh in 2022—nearly 70% of household consumption (44.7 TWh) (NVE, 2024). Enova's 2015–2025 statistics further show that over one-third of buildings' energy labels fall into the lowest classes E, F, or G, underscoring the need for large-scale upgrades (Enova, 2025).

Across Europe, buildings account for 34% of energy-related emissions (European Environment Agency, 2024). The EU's Renovation Wave, launched in 2020, aims to renovate 35 million buildings by 2030 (European Commission, n.d.). However, in both Norway and the EU, profitability, administrative complexity, and limited expertise remain key barriers, often leading to demolition instead of rehabilitation (Fjellheim et al., 2020).

Rehabilitation is increasingly recognized as the more sustainable alternative, cutting emissions from material production, waste handling, and construction activities. A study for Enova estimated an average 57% emission reduction in rehabilitated low-emission buildings compared with new reference buildings (Fuglseth et al., 2020), while Fufa et al. (2020) confirmed that rehabilitation emissions are typically half those of new construction.

While rehabilitation offers clear environmental benefits, the sufficiency of current subsidy schemes for large commercial buildings remains uncertain. At the same time, the social value of rehabilitating protected and heritage buildings has been little explored. Therefore, this study addresses the following research questions:

1. *Are current subsidy schemes sufficient to encourage the rehabilitation of larger commercial buildings in Norway?*
2. *How does the rehabilitation of commercial buildings, particularly of protected and heritage buildings, contribute to a sense of pride and social value within communities and organizations?*

THEORETICAL BACKGROUND AND LITERATURE REVIEW

This study draws on a scoping literature review in Scopus, ScienceDirect, and Elicit, complemented by document analysis of reports, policy documents, and media sources. The AI tool, Elicit, was used to support the initial identification of relevant literature. Most of the papers retrieved through Elicit had already been found in Scopus and ScienceDirect, confirming its reliability as a search method.

Articles from all databases were then thoroughly reviewed in full to assess their relevance, quality, and contribution to the study's analytical framework. The review identified economic and social barriers to rehabilitation relevant to the research questions, summarized in Table 1.

The barriers identified in the literature guided the development of interview themes, focusing on the economic dimension (subsidy design, financing, and predictability) and the social dimension (general

social value, heritage value, organizational pride, and community impact). This structure ensured that both research questions were explored consistently across the literature and empirical data.

Table 1 Identified barriers from the literature review.

Description of barrier	References
High initial costs and the need for expensive financing often discourage property owners from initiating projects.	Alabid et al., 2022; Azizi et al., 2019; Fahlstedt et al., 2024; Franco et al., 2021; Imran Khan et al., 2024; Maghsoudi Nia et al., 2024; Mikulić et al., 2021; Ohene et al., 2022, 2023; Prabatha et al., 2020; Shi et al., 2023; Villalba Muñoz et al., 2024; Weerasinghe et al., 2024.
Long payback periods and uncertainty in return on investment (ROI) further reduce willingness to invest.	Alabid et al., 2022; Imran Khan et al., 2024; Ohene et al., 2022, 2023; Prabatha et al., 2020; Shi et al., 2023; Villalba Muñoz et al., 2024.
Access to affordable financing is another barrier, with building owners struggling to secure loans for rehabilitation projects	Alabid et al., 2022; Azizi et al., 2019; Franco et al., 2021; Maghsoudi Nia et al., 2024; Mikulić et al., 2021; Nægeli et al., 2019; Ohene et al., 2023; Prabatha et al., 2020.
Subsidy and incentive schemes are widely discussed, yet their effectiveness is questioned. Many studies suggest that poorly structured or inadequate programs fail to provide sufficient motivation for large-scale rehabilitation.	Alabid et al., 2022; Franco et al., 2021; Maghsoudi Nia et al., 2024; Ohene et al., 2023; Prabatha et al., 2020; Weerasinghe et al., 2024.
Social aspects of rehabilitation remain underdeveloped compared to environmental and economic factors. Displacement of tenants during rehabilitation can cause disruption and resistance	Azizi et al., 2019; Fahlstedt et al., 2024; Nægeli et al., 2019; Prabatha et al., 2020.
Llife cycle assessments (LCAs) often fail to incorporate social sustainability, leaving gaps in understanding wider societal effects	Fahlstedt et al., 2024.
Quality of life and health benefits, such as improved indoor climate, are insufficiently quantified.	Mikulić et al., 2021.
Resistance to rehabilitation can arise from a lack of awareness, inconvenience, or perceived high costs.	Alabid et al., 2022; Imran Khan et al., 2024; Maghsoudi Nia et al., 2024; Ohene et al., 2022, 2023; Prabatha et al., 2020; Weerasinghe et al., 2024.

Findings from the document analysis

The document analysis included sources such as newspaper articles, official government websites, webinars, and policy documents. It also covered a SINTEF report recommending annual subsidy levels needed to meet national targets for emission reductions and lower electricity use. Together, these materials provided insight into policy frameworks, public debate, and expert perspectives on financial and regulatory barriers to building rehabilitation in Norway.

Analyses indicate that current subsidy levels are insufficient to make large-scale commercial rehabilitation attractive. In 2024, Enova allocated NOK 813 million to subsidy schemes for construction and real estate (Enova, 2025a). This is significantly lower than the NOK 1.6 billion annually that FME ZEN recommends should be directed specifically toward commercial buildings to unlock rehabilitation potential, highlighting a substantial funding gap for commercial projects (Sandberg et al., 2023). Stakeholders emphasize that such limited incentives prolong payback times and discourage investment, particularly compared to demolition and new construction (Henriksen & Borud, 2022; Hole, 2024). Calls have been made for stronger, more predictable support structures, including VAT exemptions, tax reductions, and a dedicated “Rehab-TEK” to tailor requirements to rehabilitation projects (Gjelsvik, 2022; ACAN Norge, 2025).

Funding for heritage buildings is fragmented, with schemes such as the Cultural Heritage Fund and the UNI Foundation typically covering 50% to 70% of costs (Klima- og miljødepartementet, 2024; Stiftelsen UNI, 2024). However, support is competitive and limited in scope. Rehabilitation of heritage structures is consistently linked to identity and pride: surveys show 96% of respondents believe cultural heritage supports tourism and business, while 68% consider it personally important (Solgaard et al., 2019). Economic studies further report a 17–22% price premium for properties in conservation areas and a 14–18% higher willingness to pay for preserved environments (Solgaard et al., 2019). Similar findings from European cities confirm significant value gains of 25–60% following rehabilitation (Mamadzhyanov, 2025).

Documented barriers include regulatory rigidity, long payback times, and uncertainty over returns (Skar, 2025; Kvellheim, 2025). Yet successful cases demonstrate strong social benefits. For instance, the rehabilitation of Sommerro Hotel in Oslo was described as creating “extreme pride” among partners and the public, combining environmental, social, and cultural gains despite higher costs (Gram, 2023). Industry voices stress that combining incentives with regulatory flexibility is essential, as “both a stick and a carrot” are needed to accelerate rehabilitation (Johannesen, 2024).

METHODS AND DATA

This study used a qualitative research design to explore how economic and social factors influence rehabilitation decisions in the Norwegian real estate sector. Twelve semi-structured interviews were conducted with thirteen participants from real estate companies, mainly owners and developers. Participants were selected for their relevance to the research questions, emphasizing decision-makers with practical experience. Recruitment occurred through company websites, LinkedIn, and snowball sampling (Nathan et al., 2019). The interviews followed a semi-structured format, combining predefined themes with flexibility to explore new issues (Doody & Noonan, 2013). The interview guide, developed from the literature review, included themes such as experience with rehabilitation, financial incentives, regulatory frameworks, and social value. Interviews lasted 45–90 minutes, were conducted digitally via Microsoft Teams, and were voice-recorded. Table 2 provides an overview of all interviews.

Table 2 Overview of interviews and assigned reference keys

Interview number	Participants	Job title(s)	Key
1	1	Director of project development	RE1
2	1	Project director	RE2
3	1	Executive Vice President, asset management and advisory	RE3
4	1	Project manager	RE4
5	2	Project manager & Director of investments	RE5
6	1	Director of development	RE6
7	1	Director of project development and building technology	RE7
8	1	Director of development	RE8
9	1	Project director	RE9
10	1	Head of projects	RE10
11	1	Project developer	RE11
12	1	Head of department Sustainability	RE12

In this study, rehabilitation refers broadly to the upgrading and reuse of existing commercial buildings, with heritage rehabilitation treated as a subtheme involving listed or culturally significant structures. Several participants discussed heritage projects, while others referred to non-listed buildings. Social value was found to arise in both, though heritage projects often amplified these effects through their symbolic and cultural significance.

The interview data were analyzed thematically. After transcription and manual correction, each interview was reviewed alongside the researcher's reflections to capture context and nuance (Nathan et al., 2019). The analysis combined deductive coding, based on themes from the interview guide such as financial incentives, regulatory frameworks, and social value, with inductive coding that allowed new themes like risk, predictability, and heritage pride to emerge. Responses were then organized in a matrix to identify patterns across interviews, highlighting both similarities and differences. The material was finally condensed to focus on findings directly related to the two research questions.

RESULTS

This section presents findings from the interviews with stakeholders in the Norwegian real estate sector. The results are structured according to the two research questions previously presented.

Experience with the current subsidy schemes

Participants frequently described current subsidy schemes as insufficient to incentivize large-scale rehabilitation projects. RE3 recounted a case where a housing company investing NOK 50 million applied for NOK 10 million in Enova support but was rejected. They noted that if the company had applied for NOK 7 million, support would likely have been granted, which they argued illustrates a lack of transparency. According to RE3, "this kind of uncertainty discourages many from initiating rehabilitation projects."

Other participants emphasized the high costs related to applying. RE2 stated that companies often spend as much on consultancy hours managing applications as they eventually receive in support. Similarly, RE4 criticized Enova's communication, explaining that "no project in Norway receives the support amount listed on their website." They described a case where a project with NOK 35 million in renovation costs, covering a new roof and retrofitted insulation, received only NOK 1.7 million in grants. RE4 questioned whether it was worthwhile to apply for such schemes.

Several participants emphasized that subsidy levels had been more effective in the past. Both RE1 and RE5 stated that 5–10 years ago, Enova offered significantly higher levels of financial support, which led to more energy efficiency projects. RE1 added that municipal subsidies, such as those available in Oslo, make it easier to reuse old materials, though they do not make rehabilitation more profitable. RE12 also stressed that "current subsidies from Enova are very low compared to the costs involved."

Most participants underlined that subsidies and tax-related incentives directly influence investment decisions. Eleven participants stated that if subsidy and tax incentives were strengthened or adjusted, they could influence the choice to rehabilitate, and the scope of measures implemented. Nine agreed that increased subsidies could raise the rehabilitation rate, two were uncertain and one disagreed.

Several participants highlighted direct subsidies as the most effective mechanism. RE7 described them as "more traceable in terms of what outcomes are being rewarded," while others emphasized their predictability and simplicity in assessing project feasibility.

Suggestions for improvement

Participants proposed several improvements to existing schemes. RE6 emphasized the importance of introducing tax-related incentives to encourage its company's projects. Others supported this idea, mentioning reduced property taxes, lower valuations for wealth tax purposes, and the possibility of expensing rehabilitation costs immediately rather than depreciating them over time. RE9 highlighted the need to design financial incentives that also include small-scale property owners. They noted that in Oslo, most owners have only a single building and "lack the economic capacity to undertake major rehabilitation projects without external support."

In addition to financial measures, several participants called for simplified application procedures, greater transparency, and larger, more predictable subsidies to enhance the schemes' impact on decision-making.

Social aspects of rehabilitation

Almost all participants reported that rehabilitation projects generated pride within their organizations, among tenants, and in local communities, especially those involving heritage buildings. Several participants referred to projects in Oslo that were perceived as giving something back to the community, creating spaces that people were proud to live in, even when the projects were not economically sustainable.

RE8 expressed a strong appreciation for heritage buildings and wished to see more of them in their hometown, describing the region as “starved” of such opportunities. Similarly, RE2 emphasized that heritage buildings add a “soul” to areas dominated by new construction. They explained how working with protected buildings created a unique atmosphere and noted that one of their projects had won awards.

RE11 described a project in which an old warehouse was transformed into a community hub with food and entertainment, contributing significantly to local social life. Although the building was not protected, RE11 stressed that such projects can foster social inclusion without heritage status. RE10 shared similar experiences, noting that while some technical solutions, particularly in heritage buildings, were not fully optimal, users were highly satisfied and thrived in the rehabilitated spaces.

Several participants stated that their companies had become closely associated with major rehabilitation projects they had carried out. These were described as flagship buildings that organizations took great pride in. RE5 explained that their company, previously known for plain commercial buildings and warehouses, undertook a protected project of cultural significance in central Oslo “to give something back to the city,” even though it was not profitable. Many participants shared this view, describing the rehabilitation of historic buildings as both a contribution to cultural preservation and a source of legitimacy and pride for their organizations.

DISCUSSION

The literature identifies insufficient financial incentives and weak integration of social sustainability as key barriers to rehabilitation. The interviews expand on these themes, providing concrete examples from Norwegian real estate actors. Although the two research questions may appear separate, the results reveal their interconnection: both address the conditions that enable or constrain rehabilitation. Financial factors, such as subsidy schemes and social value derived from heritage projects, together determine whether rehabilitation is pursued.

As all participants represented building owners and developers, their views may reflect bias toward financial interests. However, this perspective was essential for understanding how policies shape investment behavior. Future studies should include policymakers, consultants, and independent sustainability organizations to capture broader perspectives.

Subsidy schemes and economic enablers

A key finding was the widespread perception that current subsidy schemes do not provide sufficient incentives for large-scale rehabilitation. This aligns with literature describing such schemes as poorly adapted to drive major projects. The interviews add nuance, showing that limited grant sizes, lack of transparency, and administrative burdens discourage investment.

This raises the question of whose perspective defines sufficiency. Participants, representing real estate stakeholders, stressed that “the subsidies are way too low” and often not worth the effort of applying. From a governmental standpoint, however, subsidy design must balance fiscal constraints, EU state-aid rules, and broader policy objectives. These differing perspectives reflect the evolving nature of Norwegian support schemes, where funding levels have shifted with political priorities.

Participants also emphasized the need for predictability and stability in support structures. This corresponds with earlier studies showing that long payback periods and uncertain returns reduce investment willingness. Calls for more direct subsidies and simpler applications echo FME ZEN's recommendation for stronger support targeting commercial buildings.

Tax-related incentives were frequently proposed as complementary measures. Consistent with international research, participants argued that fiscal tools strongly influence investment decisions. Suggestions such as lower property taxes, reduced asset valuations, or immediate expensing of rehabilitation costs highlight a need for instruments that directly improve financial feasibility. For small-scale owners controlling a single building, such measures are often essential, emphasizing that subsidy design affects not only the scale of rehabilitation but also who can participate.

Social value as a rehabilitation enabler

Although the study addressed rehabilitation broadly, some participants discussed heritage projects while others referred to ordinary commercial buildings. This indicates that social value can emerge both from heritage rehabilitation and from the adaptive reuse of non-heritage structures. The second research question examines how heritage rehabilitation contributes to social value. Most participants described projects that generated pride within organizations and communities, supporting earlier studies linking heritage rehabilitation to identity, legitimacy, and increased willingness to pay for preserved environments.

Participants described heritage rehabilitation as “giving something back to the city” and emphasized that such projects strengthen both organizational reputation and community belonging. It was stated that heritage buildings provide a “soul” to otherwise homogenous areas, while others explained how a former warehouse was transformed into a community hub. These examples reflect the literature's recognition that rehabilitation can generate cultural and social benefits that extend beyond financial metrics.

At the same time, the interviews showed that social value does not always align with profitability. Participants acknowledged that flagship rehabilitation projects often operate at a financial loss, yet they pursued them because of the symbolic and reputational benefits they bring. This illustrates a gap identified in the literature, where life cycle assessments and cost-benefit analyses rarely incorporate social sustainability dimensions. By documenting how actors in the real estate sector themselves highlight these social outcomes, this study provides empirical support for expanding evaluation frameworks to include pride, identity, and community value.

The link between economic and social enablers

A main contribution of this study is that it shows how economic and social factors are connected. When subsidies are considered too weak, this limits not only the financial feasibility of projects but also the willingness to carry out rehabilitation that could create social value. At the same time, the pride and legitimacy linked to heritage projects can make actors choose rehabilitation even when it is not profitable. Taken together, the findings point to a broader perspective: both economic and social factors influence whether the real estate sector decides to rehabilitate. Existing literature has primarily emphasized environmental and financial barriers, while this study highlights that social sustainability is an underutilized but powerful enabler. By connecting the experienced limitations of subsidy schemes with the reported social value of rehabilitation, the study expands the knowledge base on what motivates real estate actors to choose rehabilitation over new construction.

CONCLUSIONS

This study examined how economic and social factors influence rehabilitation decisions in the Norwegian real estate sector. It addressed two questions: whether current subsidy schemes sufficiently encourage large-scale rehabilitation, and how heritage rehabilitation contributes to pride and social value.

Findings indicate that existing subsidies are widely viewed as inadequate. Participants cited low support levels, lack of transparency, and administrative burdens as key barriers, echoing previous research. Suggested improvements included stronger direct subsidies, tax incentives, and simpler applications, particularly to support small-scale owners. These insights show that subsidy design affects both the scope of rehabilitation and who can participate.

The study also demonstrates that heritage rehabilitation generates considerable social value. Participants highlighted pride, identity, and legitimacy within organizations and communities, even when projects were financially unprofitable. These findings expand existing literature by underscoring social sustainability as a distinct motivation that complements economic and environmental considerations.

By linking weak financial incentives with the social benefits of rehabilitation, the study provides a broader understanding of what enables real estate actors to choose rehabilitation over new construction. Economic and social factors are closely connected: limited subsidies can restrict socially valuable projects, while pride and community benefits can drive rehabilitation despite low profitability.

Although grounded in the Norwegian context, the findings have broader relevance. Similar challenges with subsidy schemes are reported internationally, and the focus on social sustainability supports ongoing European policy initiatives such as the Renovation Wave and the revised Energy Performance of Buildings Directive. For facility management practice, the study highlights the need to integrate economic frameworks and social value to advance rehabilitation and meet climate goals.

AI DECLARATION

ChatGPT was used solely for language editing and improving overall flow, while Elicit was used to help find and collect relevant literature. All data were collected and analysed by the researchers, and all interpretations and conclusions are entirely the authors' own.

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Greening Campuses for a Sustainable Future: Enhancing Awareness through Living Labs

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ABSTRACT

Background and Aim. Developing green campuses anticipates to contemporary environmental and health challenges by enhancing biodiversity with green spaces and promoting well-being through outdoor education and active pathways. Inspired by The UN Sustainable Development Goals (SDGs), this paper highlights living lab examples from two Dutch university campuses (A and B) in order to explore effects of campus greening and related awareness change for students, enhancing future campus management practices.

Methods. In a living lab students conduct action research and experiment in the campus environment with micro interventions in an iterative process. This involves participatory planning sessions, where students from different studies engage in outdoor activities and study the effects of changes in green space on campus. In living labs, campus management, greening experts, and campus users (e.g., students, employees, entrepreneurs, and visitors) are involved.

Results. Students experience the health and well-being benefits of green outdoor spaces and foster greater social cohesion. Students learn about climate action through the impact of greenery on biodiversity and climate adaptation. This increases awareness on sustainable development.

Originality. Through co-creation in living labs with experts, stakeholders and student participation, we develop the sustainable campus of the future that anticipate real-life challenges.

Practical Implications. This explorative research offers practical strategies for greening campuses, enhancing well-being, fostering community, create awareness on climate action and advancing awareness among students and campus management about sustainability.

Type of Paper. Full Research

KEYWORDS. green campuses, facility management, student well-being, enhancing awareness, sustainable development

INTRODUCTION

There is a growing trend of attention towards creating a healthy and sustainable campus environment (Coöperatie SURF, 2023). While both academic and policy literature debates increasingly emphasize the importance of sustainability, well-being, and future-proof campus development, green environments are still rarely integrated into campus management (Kuo et al., 2018; Requia & Adams, 2022; Van Den Bogerd, Nicole et al., 2018; van den Bogerd, Nicole et al., 2023; van Dijk-Wesselijs et al., 2020) There is a clear need for more research into the tangible effects of a green campus environment. This paper shows how green space on campus can contribute to a (positive) experience of campus users. Campuses A and B share the vision that the campus environment should be an inviting and pleasant place to stay, fostering a sense of well-being, and encouraging sustainable behaviour. This vision, inspired by the UN Sustainable Development Goals

(SDGs): Good Health and Well-being (SDG 3), Sustainable Cities and Communities (SDG 11) and Climate Action (SDG 13), aligns with future campus development trends. These SDGs are guiding principles in this research on campus greening to enhance their visibility and impact. In conversations with students and campus stakeholders, a clear desire emerged for a greener campus environment that enhances comfort and well-being, particularly in response to rising temperatures causing different parts of the campus unpleasant to stay in. This research aims to provide clear insights into the benefits of a green campus, particularly to support decision-makers who may still be unconvinced of its positive impact and to raise awareness among students, which we actively involve in this explorative research. This paper intends to answer the following main research question: How can living labs enhance awareness to develop the green campus of the future?

To answer this main question, the following sub-research questions are explored:

1. To what extent can green spaces contribute to students' health and well-being?
2. How do greening initiatives influence social cohesion among campus users?
3. In what ways can green spaces contribute to climate action?

LITERATURE STUDY

In recent years, the role of green environments has increasingly gained attention. This research focuses on the relationship between green spaces and their potential impact in three interrelated domains: health and well-being (e.g., more green improving health and well-being, SDG 3), social cohesion (e.g., foster social cohesion, SDG 11), and climate adaptation (e.g., climate action and awareness, SDG 13). By reviewing existing literature, this research aims to examine how green spaces contribute to student' well-being, foster a sense of community and social connectedness among campus users, raise awareness of The UN Sustainable Development Goals (SDGs), and support the achievement of broader environmental goals related to climate action.

Green space and well-being

Studies on green space suggest a positive relation(ship) between green space and health and well-being. Air pollution is, for instance, lower in green areas (Markevych et al., 2017). Also, there may be a relation between exposure to greenery and improved physical health, lower incidence of type II diabetes, and a lower risk of depression and depressive symptoms (Fong et al., 2018; Twohig-Bennett & Jones, 2018). Systematic reviews and meta-analyses of available epidemiological studies conclude that there is consistent evidence that exposure to greenery is associated with better self-reported mental health (Van den Berg et al., 2015). Also, exposure to greenery is positively associated with emotional and behavioural problems (Vanaken & Danckaerts, 2018) and a reduced chance of developing ADHD (Van Aart et al., 2018). Specifically in the transition from child to adult, access to green space is associated with improved mental well-being, general health, and cognitive development (Engemann et al., 2019; McCormick, 2017; Sprague et al., 2022). The meta-analysis by Pritchard et al. (2020) suggests a positive relationship between nature connectedness and eudaimonic well-being, such as a sense of fulfillment and meaning in life (Pritchard et al., 2020). This points to the psychological benefits of a strong connection with nature. A study at the University of Twente found that students rated outdoor spaces with "greenery" higher in preference and perceived restoration likelihood than those without. This effect was stronger among students with a high connectedness to nature, suggesting they value the integration of greenery on campus (Ruan et al., 2024). We hypothesize that students could benefit from the integration of greenery in a campus environment, which may also have a positive impact on their experience, health, and well-being.

Green space and social cohesion

Nature may also be an important reason or trigger for meaningful experiences, social cohesion, and livability on campus. Several studies suggest that re-connection with nature can help improving social interaction. Prins et al. (2023) highlight the importance of nature in social and cognitive interactions in early education (Prins et al., 2023). An experiment of children being more outside during

educational classes shows greater interest in nature from children participating in the “nature group” in relation to the control group. There is a stronger preference for “wild” over “managed” nature, which is also associated with a significant improvement in emotional well-being (Van Der Waal et al., 2008). If it influences young children in a positive way, how positive will nature influence students on campuses? According to the research from Van Den Bogerd et al. (2018) greening on campuses has indeed positive effects on students; it may even lead to increased physical activity and better concentration and social interaction. Research of Powers (2004) suggests that education in a natural environment may lead to more involvement and awareness and increased academic performance of students. Green appears to be an important mechanism for promoting personal development and meaningfulness. Natural environments seem to offer favourable conditions for meaning-making and coping processes (Powers, 2004). According to research from Van Den Bogerd et al. (2018) students prefer a green environment more than a non-green environment on campus. Nature promotes a positive mood that can support recovery from adverse events and restores hope and perspective. Students expect to recover better from study pressure at a green campus square than on a standard grey square (Van Den Bogerd, Nicole et al., 2018). Natural elements and places work for many people as symbols that refer to ‘deeper’ beliefs and values that align with their life goals. This can manifest itself in a ‘sense of place’ or a ‘sense of belonging’, an emotional bond and identification with a specific place or area. The natural areas with which an emotional bond and identification is established can be wilderness, but also urban greenery such as trees, (community) gardens, or areas of rough land and water (Hartig et al., 2014; Van Der Waal et al., 2008). If campuses would offer and develop more green spaces, positive effects at students’ social cohesion can be expected.

Green space and climate action

Climate change has consequences for the urban environment. Heavy rainfall could cause flooding. Higher temperatures can lead to heat stress and extended drought periods can cause damage to infrastructure. Green on campus can improve climate adaptation, such as lowering temperatures and absorbing water, and at the same time increase biodiversity on campus by taking climate action (Western Resource Advocates, 2025). To co-create and develop green campuses, it is important to include all target groups on campus. From the perspective of climate adaptation our campuses should be able to withstand these extreme climate conditions. Especially in urban environments there is a greater chance of the “urban heat island effect”, due to a lot of asphalt and stone (heat stress) that raises the temperature up to 7 degrees more than in the countryside (De Nijs et al., 2019). The adaptation of green spaces is the solution for climate adaptation and CO₂ storage in urban areas. Research at the campus of Wageningen University showed that the role of soil and the type of green is very important (van Velthuisen et al., 2023). These scholars showed that soil under “trees” and “shrubs” are better for climate adaptation and biodiversity compared to “lawns”. Wageningen University also studied the effects of 11 tiny forests (a green mini oasis) in the Netherlands and concluded that it had a positive impact on biodiversity, CO₂ and water storage, and heat-stress reduction (Ottburg et al., 2022). Implementing small green interventions on campus may support climate action for biodiversity and climate adaptation. It also raises awareness about the topic to actually take more climate action on campus. Drawing on a growing body of literature, it highlights how green spaces on campus can act as a crucial link between health and well-being, social cohesion and climate adaptation. The integration of greenery supports students’ mental and physical health, fosters social connectedness and a sense of belonging, and contributes to environmental resilience through biodiversity and climate regulation. These interconnected benefits demonstrate that greening campus environments is not only an aesthetic or ecological improvement, but a strategic and holistic approach to advance multiple SDGs simultaneously. These findings notwithstanding, it is however unclear how this related to awareness and action. As we have described above, it was pre-supposed that not all decision makers and users are convinced about campus-greening benefits. We postulate that a living lab with participation of students can be helpful to realize change and raise awareness on this topic.

METHODS

In these current living labs, a collaboration among students, researchers, and other stakeholders is intended to foster the vision of a future campus and to promote campus greening. A living lab is a real-life environment where students perform action research in a small-scale campus environment. Action research is a co-creative approach aimed at both understanding and improving practice through cycles of empathizing, prototyping, testing, reflection and action in an iterative process. It is a participatory and practice-based form of inquiry that seeks to generate knowledge while simultaneously creating meaningful change in collaboration with stakeholders involved (Bradbury, 2015; Kemmis & McTaggart, 2007). This approach emphasizes reflexivity, co-creation, and aligning with critical qualitative traditions that aim to transform both understanding and practice (Denzin et al., 2024). The campuses A and B that are selected for this research are knowledge partners on campus design, both having substantial experience in running living labs. Students from various disciplines, such as social studies, built environment, placemaking, and facility management, work together to address SDG-related problems on campus. The opportunity for students to participate in our living lab was advertised to all students from both universities of applied sciences and they could apply voluntarily (randomly selected). All students are enrolled at one of the two campuses and are between 18 and 26 years old. This paper showcases a short overview of the action research with students, that was executed in the living labs in 2025 at Campus A and B. In each living lab on average ten students performed action research on campus in which they involved campus management, municipality, greening experts, and campus users (e.g., students, employees, entrepreneurs, and visitors), varying from 25 to 75 participants in each research action. On average student collaborate with each other in around twenty living lab sessions of which three sessions are together with campus management and stakeholders. For the different sub-questions, we employed various action research methods:

Green space and health and well-being. To extent how green spaces on campus can contribute to student well-being (e.g., green space to improve student well-being, SDG 3) a photovoice “snapshot” method was used to study characteristics of students favorite outside places on campus. The photos were collected by a qualitative research method using participatory photography, where photos were conducted in real-life situations through the lense of students. Data was collected using a questionnaire where students submitted their favorite place to be outside on Campus A and Campus B, including an explanation why this was their favorite spot. 50 students participated in this research: 25 on campus A and 25 on Campus B (randomly selected).

Green space and social cohesion. To research in what way greening initiatives influence social cohesion (e.g., influence of green space on social cohesion, SDG 11) among campus users a placemaking game, using the Place Making Diagram (Project for Public Spaces, 2018), was organized to research how green spaces are used by campus users. The Project for Public Spaces (PPS) evaluated thousands of public spaces around the world and found that to be successful, shared qualities such as accessibility, comfort, activities and sociability, need to be developed (Project for Public Spaces, 2018). Using the Place Making Diagram, campus users and students are exploring, rating, designing and evaluating these shared qualities of an outdoor place on campus in three placemaking game sessions. The sessions were organized in a living lab at Campus B, with 20 participants (campus users and students randomly selected). In this place game participants rate the place by exploring and rating a space on accessibility, comfort, activities and sociability. The rating is discussed with participants and the most important point for improvement were further refined in student groups to make a new design. This design was presented again in an iterative process. The outcomes of all different designs are used in a final design with facility and greening experts to transfer the space into a meaningful place. This is an iterative process with different and ongoing groups of students and other campus users to make the campus a better and meaningful place.

Green space and climate action. To research climate action (e.g., greening activities contribute to climate action awareness, SDG 13) on campus, greening activities were organized in Living labs at both campuses combined with small-scale research projects with students. It was intended to raise awareness and stimulate behaviour that increases climate action on campus. In this paper we give three examples: 1) on campus B we did a green intervention Flip the Tile where 20 campus users

flipped 150 tiles into 10 small green spots on the campus squares. Afterwards students interviewed participants (n=18) on greening campuses. 2) At Campus A practice days and biodiversity scans were executed by using the green schoolyard evaluation tool (GSET) followed by a focus group evaluation. The GSET is a tool that was created based on a two-round Delphi study to support and evaluate the design of schoolyards on child development, biodiversity and climate reliability for research and practice (van den Bogerd, N. & Maas, 2024). In a living lab 10 students at campus A went onto the campus themselves and completed the GSET quick scan. Afterwards, in a group session with campus experts the results were discussed. 3) to analyse climate adaptation on campus B, digital-twin was used. The digital-twin tool was used to measure the temperature, shown on a heat map of the campus, before and after planting trees as a green intervention on the predominantly paved square. Afterwards, the temperature in the 'real-world' was tested with sensor data.

While the research and results focus on the relation to the SDGs as outlined in the sub-questions, the overarching aim of raising awareness is not directly visible in the results but is addressed in the discussion paragraph.

RESULTS

Action research in living labs on green spaces show the following results.

Green space and well-being

To what extent can green spaces contribute to students' health and well-being? Photovoice "snapshot" action research shows that students react positively on green spaces and facilities on campus to meet others or sit down to relax. Results show that all (n=25) photo's, taken at Campus A "green space" is visible (e.g. Figure 1).



Figure 1 A selection of photos taken on Campus A. Source: Authors' own work.

While some students find their spot more on the outside of the campus in nature areas, others prefer a spot in the center of the campus. A building is visible in 17 photos, of which 65% is an educational building. 15 photos show tiled ground, most of which (67%) are a walking path. 44% of the pictures show a place to sit down. The descriptives were documented in Table 1.

At Campus B almost the same findings were experienced (Figure 2). In this case, all (n=25) favorite places were marked by a green space, air and buildings. In 24 photo's there is also tiled ground visible. This could be explained by the huge square with tiles in the center of the campus. The most common building types that were pictured were educational buildings (n=20). Some photos show the community building, Greenscape (n=4) or the windmill (n=4). The Greenscape is a community house in a green environment on Campus B, as showed in Figure 2, the right photo. The descriptives were documented in Table 1.

Table 1 Characteristics of outdoor spaces on Campus A (n = 25) and Campus B (n = 25)

Location	Count	Campus A		Count	Campus B	
		% of all	% of type		% of all	% of type
Green space	25	100%		25	100%	
Lawn (grass)	22		88%	13		52%
Trees	20		80%	21		84%
Shrubs and low wild vegetation (flowers, herbs)	7		28%	7		28%
Planter (not soil)	1		4%	9		36%
Air	17	68%		25	100%	
Water	11	44%		9	36%	
Buildings	17	68%		25	100%	
Tile ground	15	60%		24	96%	



Figure 2 A selection of photos taken on Campus B. Source: Authors' own work.

The answer on the question “why” this is their favorite outside spot on campus showed different outcomes. At Campus B respondents choose this place most of the time because of the water (n=11) or green space (n=8). Respondents indicate that it is nice to sit in the sun (n=10) while others named shadow (n=4). Respondents also indicate that this is their favorite spot, because it has places to sit down (n=7) or meet others (n=5). Four respondents make the connection themselves between being in their favorite space means that the green environment gives a nice feeling (n=4). Other respondents refer to their favorite place as a place that feels welcoming, familiar or safe (n=3). Quote of a student about the inspiration garden at Campus B: *“It connects you with nature and makes my mood exponentially better during rainy days in spring”*. At Campus A respondents refer most of the time to green space (n=10) and because there is a place to sit (n=7), to walk/walkpath (n=7) or meet others (n=4). Other respondents choose this place because it is near to an educational building (n=4) or near to food (n=4). This photovoice “snapshot” research shows that all of the participating students (respondents) “capture” green space on their photo and therefore it can be assumed that they prefer green space on campus which will improve well-being of campus users (e.g., green space improves well-being, SDG 3). By conducting this research in living labs, both students and participants are more aware of the importance of green space and well-being on campus.

Green space and social cohesion

How do greening initiatives influence social cohesion among campus users? To enhance social interaction, the place making method is used. At Campus B, an intervention was executed by making a green spot with a community house named the “Greenscape” for campus users. In the living lab on Campus B a place game was performed by filling in a Place Performance Evaluation. This tool helps initiating placemaking to cocreate a meaningful place and was executed by 20 representatives (n=20) of campus users and stakeholders (municipality, education, experts and students). The Place Performance Evaluation provides a scan, which measures the categories: comfort and image; climate adaption; access and linkages; uses and activities; sociability. The results of the place performance evaluation are showed in Table 2.

Table 2 Results of place game session and place performance evaluation Greenscape on Campus B

DIMENSION	Score: Poor =1, good = 4 / n=20	
	Average score	n
COMFORT AND IMAGE	4	20
CLIMATE ADAPDATION	3	20
ACCESS AND LINKAGES	3	20
USES AND ACTIVITIES	1	20
SOCIABILITY	1	20

The results in Table 2 show good scores (>3) for the following items: comfort and image (safety, green, clean, attractive etc.), climate adaptation (socio-environ mental value, active participation, sense of ownership etc.) and access and linkages (accessible, walkable, connected etc.). Low scores (<2) were given to uses and activities (fun, vital sustainable etc.) and sociability (welcoming, interactive, cooperative etc.) due to the lack of a structural programming of activities. All the participants indicated that they would join activities if they were organised in this green place on campus (e.g., influence of green space on more social cohesion, SDG 11). The multidisciplinary session finally results in a creative design drawing concept which was presented to each other, offering short-term and long-term improvements for the "Greenscape" as a small-scale example for the future development of a green campus.

Green space and climate action

In what ways can green spaces contribute to climate action? At Campus B an intervention with Flipping Tiles was executed. By this project of flipping tiles awareness was created, due to a simple but effective and practical way by adding more visible green spaces on the campus. Campus users (n=30) flipped 150 tiles and added 10 spots in and around the Greenscape with greenery and flowers. Afterwards students did a short research project to raise knowledge about biodiversity by filling out a survey on the use of green spaces. Output was that lecturers (n=4) had no time, interest, or opportunity to engage in biodiversity action. Students (n=14) however, were interested in the subject biodiversity and if facilitated and organized they would take part in such activities. The results show that all participated students do want to contribute to increase biodiversity, but because of limitations, such as knowledge, time, money, green space, they do not see the possibility to act/execute (perceived control).

At Campus A, a contribution to climate adaption, was made during a practice day with students (n=8) analyzing the campus by using a biodiversity quick scan of the Green School Evaluation Tool (GSET) (van den Bogerd, N. & Maas, 2024). The students went onto the campus themselves and completed the quick scan. Afterwards, the results were shared and discussed with campus management experts. The results of the biodiversity scan showed that on average 21-40% of the public space is green. Students noted: "The use of variety in biodiverse greenery has been taken into account, but its creativity remains limited for the time being". For biodiversity and climate adaptation it is important in campus design that a significant percentage of the ground surface consists of natural substrates (e.g. grass, sand, soil, wood, gravel). For campus A this is less than 20%. In a short focus group discussion at campus. Students reported increased awareness of the SDGs after participating in the Living Lab by using the SDGs as a practical framework to demonstrate their sustainable impact in upcoming projects. Furthermore, students indicate the importance of being in a multidisciplinary group and learn from each other. Students show in the discussion that they are more aware of the positive effects of green campuses because of their research and especially the relation with human and nature gave a new perspective about the importance of green spaces (e.g., greening activities contribute to climate action awareness, SDG 13). Also, students noted their professional learning curve, particularly giving value to their future decisions. Students experience also more connection to the campus environment and nature.

On campus B, digital twins were used on the campus environment to discover the effect of planting trees on campus as a green intervention and contribution to climate adaption (heat-stress). Digital twin shows how the temperature on campus is measured before and after the implementation of

placing 210 trees on the main tiled square. A major difference in perceived temperature (Figure 3) is visualized in the two pictures, before and after the green implementation.



Figure 3 Digital Twin: temperature at Campus B before (left) and after (right) planting trees

After the digital twin method, the temperature was measured with sensors on plants and trees. Figure 5 shows the data of the sensors. Over time, the “tiny forest” on the right side of Figure 4 is on average 3 degrees cooler than the area in front of the building on tiles (number 862), see Figure 5. Trees that are placed individually on the main square have more differences in temperature and experience more heat than trees that are surrounded by other trees. This difference concerns the measured temperature, for the perceived temperature this effect will be even larger.

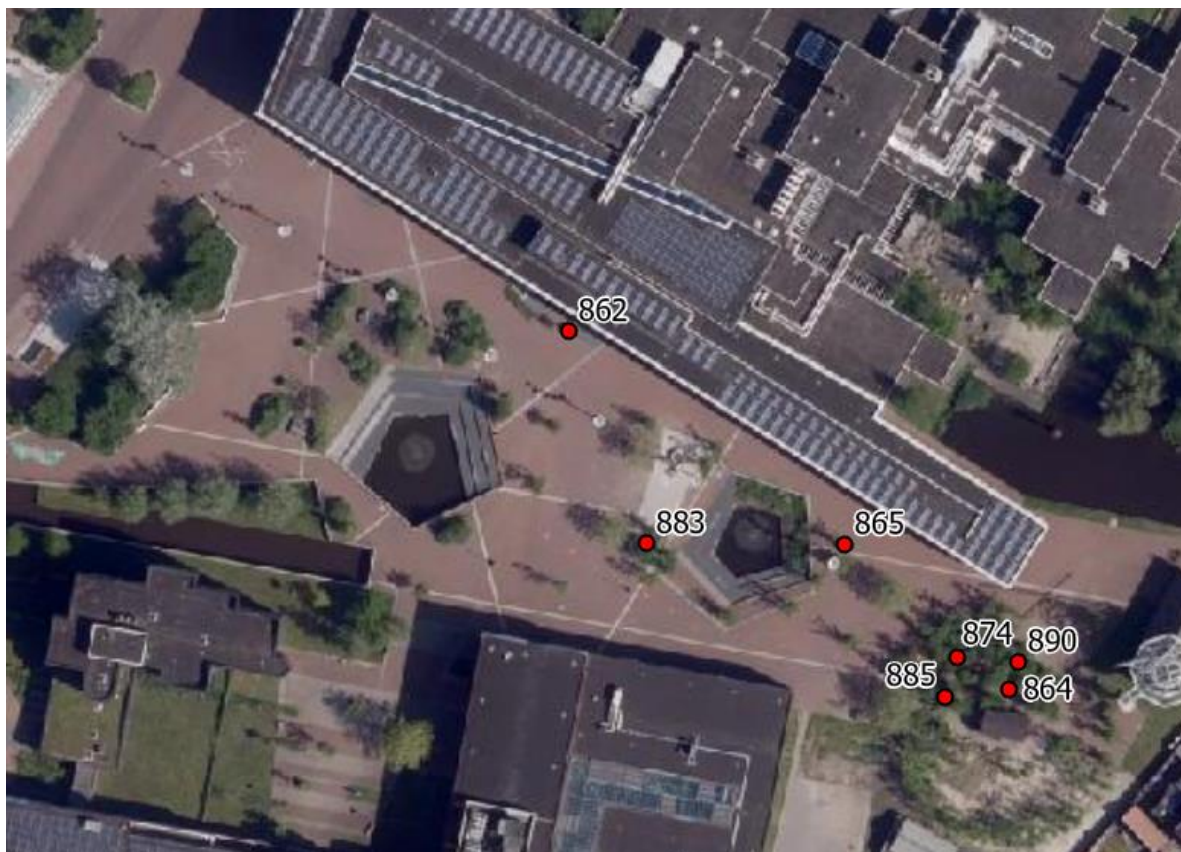


Figure 4 Identification of different plants and trees

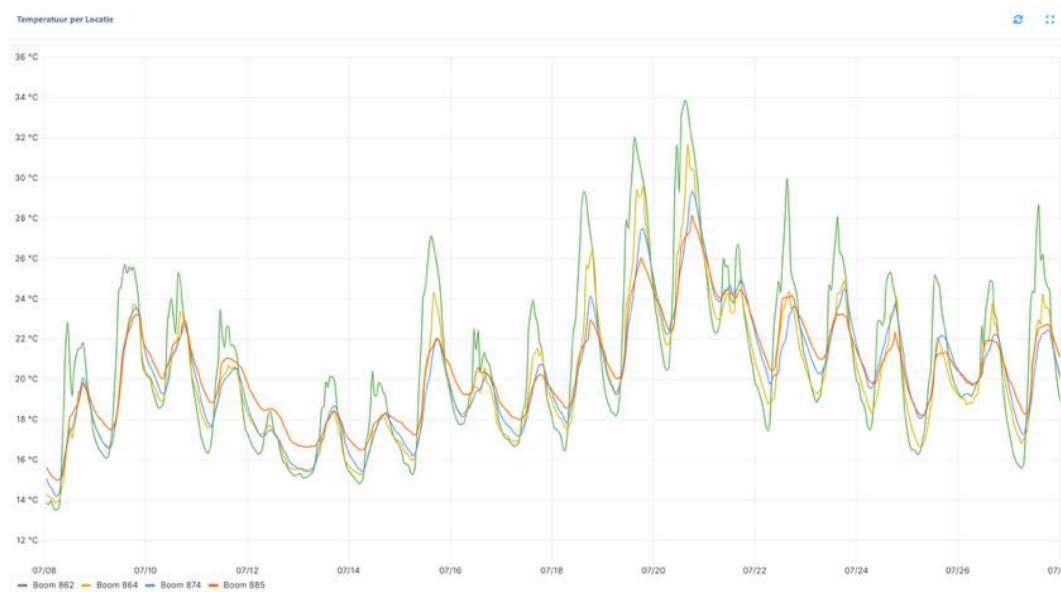


Figure 5 Measured temperature plant/trees in time

DISCUSSION

A green campus may be able to contribute positively to both its users and the natural environment. Studies indicate that it is reasonable to assume that a green campus will not only support climate adaptation, such as reducing heat stress and increasing biodiversity, but also inspire campus users to adopt more sustainable practices. Students will be more aware of sustainable development and create a collaborative effort to improve green on campus, making it a better place for all campus users. The aim of this paper is not to evaluate the existing body of literature or to critically assess the strength of evidence related to green campuses. Rather, this study takes an exploratory research approach, focusing on the potential of green campuses to inspire campus management, practitioners, and researchers. Through a small-scale, practical action research in living labs, the goal is to offer accessible, insights that can contribute to the development of best practices and future policy recommendations. By doing so, the paper seeks to raise awareness of the role green campuses can play in sustainable development and to strengthen our collective connection with nature.

Limitations

Three small-scale practical studies employing action research in living labs show that green improves well-being (e.g., green space improves well-being, SDG 3), social cohesion (e.g., influence of green space on more social cohesion, SDG 11) and climate action spaces (e.g., greening activities contribute to climate action awareness, SDG 13). This research was characterized by limited data collection such as single interviews or surveys with a small number of participants. As a result, several limitations must be acknowledged. Although the small sample size limits the generalisability of the results, this was not the research objective. Rather, the research was intended as an exploratory inquiry to gain initial insights into the topic. The limited scope of the research and data collection methods may reduce the depth of insight into complex issues, potentially overlooking nuances or variations across different settings. Despite these limitations, the research provides valuable practical insights and serves as an exploratory foundation for future, more comprehensive studies.

Insights, awareness implications and future research

Green space and well-being. With the photovoice snapshot study, the first step is made towards understanding what students/campus users (campus A and B) would like to see on campus regarding greening. Results in this paper show the value of green spaces for students, which is an initial step toward decision-makers for a greener campus. Conducting further research into the needs of campus users in outdoor spaces will provide insight into greater awareness of the benefits of greenery on

campus, for both students and campus management. If you're involved in the participation process, you're more likely to use it sooner and share the benefits of this green space with others to raise awareness.

Green space and social cohesion. A co-created and bottom-up intervention on Campus B, the green spot with the community house “Greenscape”, enhances social interaction on campus by using the Placemaking method. While hard to quantify because of an average number, the co-creating sessions suggest increased collaboration, social interaction and awareness, especially among already engaged students and stakeholder participants.

Green space and climate action. The living lab project raises awareness and positive impact at campus environment by planting 210 trees at the campus square B to reduce heat. However, the ‘real-life’ implementation of biodiversity and climate-adaptive measures for climate action is more challenging. Dialogue and shared responsibility (ownership) are essential first steps; measurable impact requires further research.

The living lab activities also seems to serve a broader purpose: raise awareness about sustainable development by more engagement from student participations and/or other campus users through cocreating campus greening. This increase of awareness strengthens education for sustainable development in both living labs. This can also be linked to Quality of education (SDG 4). Green campus initiatives foster engagement, self-confidence, and a sense of belonging among students. Informal, outdoor activities enhance social skills and learning environments. While this exploratory approach has its limitations, the findings clearly show that green spaces contribute positively to the experience of campus users. Integrating greenery into education through living labs with real-life implications yields tangible results—enhancing student well-being, fostering social cohesion, and supporting climate action through improved biodiversity and adaptive measures. Expanding or upscaling the use of living labs for campus greening can play a meaningful role in advancing the SDGs, particularly in promoting education for sustainable development. Future research should prioritize:

- evaluating the effects of green interventions within specific campus contexts, as outcomes are often highly location dependent,
- providing clear insights into the maintenance needs and long-term value of green environments to inform decision-makers
- comparing costs with ecological, social, and educational benefits which can shift thinking from cost-driven to value-driven,
- exploring how student involvement enhances awareness and engagement. While current findings suggest its importance, further research can help clarify its long-term impact and how best to foster ownership.
- leading by example, i.e. encouraging campuses to begin with small, practical interventions. As knowledge institutions, universities have a responsibility to future generations—creating green and meaningful campuses is a concrete step towards a more sustainable world.

CONCLUSION

This research shows that students value a green campus and that involving them through living labs increases awareness of sustainable development. The living lab, as a real-life experimental setting, proves to be a powerful construct for translating the Sustainable Development Goals from the United Nations into local, actionable change at campus. By combining participation, co-creation, and multidisciplinary collaboration, living labs engage students, staff, and partners in developing future-proof, resilient campuses. This approach not only raises awareness, but also empowers stakeholders to co-create meaningful, sustainable solutions. This explorative research integrates action research and co-creation in living labs with a bottom-up & multidisciplinary approach, showcasing how collaborations of Facility Management with students and external partners on greening initiatives can

advance SDGs and developing the (green) campus of the future that anticipate real-life challenges. This paper can be an inspiration to the Facility Management community and education to apply this exploratory approach to co-create the campus of the future, as many small steps can make a major difference.

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Challenges and Opportunities in Applying Participatory Backcasting for Climate-Resilient Hospital Estates

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ABSTRACT

Background and Aim. The National Health Service in England is committed to achieving net-zero emissions by 2040, while also adapting to the impacts of climate change. However, long-standing barriers stem from estate management, financial constraints, and organisational development, which limit innovation among hospital Estate and Facilities Management (EFM) professionals. Adopting a Participatory Backcasting (PB) approach can help by realigning maintenance plans with future goals. This paper explores the use of PB in a project focused on climate change mitigation and adaptation through improved estate asset management.

Methods and Data. This paper presents the results of the two workshops involving a multidisciplinary team of 14 participants. The workshops aimed to translate a holistic vision of the future sustainable and climate-resilient hospital estates in 2050 into specific performance criteria for an existing hospital estate in terms of SMART objectives and KPIs.

Results. When PB is applied to the existing hospital estate, issues related to EFM's role in leadership, lack of strategic planning, decisions driven by funding availability, and a focus on immediate tasks make it difficult for participants to disentangle themselves from daily challenges and consider long-term objectives. Additionally, the lack of centrally developed guidelines for SMART objectives and KPIs associated with the greening agenda creates barriers to identifying performance criteria for the existing estate.

Practical Implications. Applying BP with EFM professionals may require new methodological enquiries to co-create effective data collection activities that consider the power dynamics within trusts and meet stakeholders' knowledge and expectations.

Type of Paper. Full Research

KEYWORDS. climate change, existing hospital estate, participatory Backcasting (PB), mitigation and adaptation

INTRODUCTION

In 2022, the NHS in England became the first health system to incorporate net-zero principles into legislation with the Health and Care Act 2022, aiming for net-zero emissions by 2040 for emissions under its control and 2045 for emissions it can influence (Department of Health and Social Care, 2022). Following the 2008 Climate Change Act, NHS England and healthcare organisations must also adapt to the impacts of climate change. The NHS operates over 1,200 hospitals and nearly 3,000 treatment facilities across approximately 24.3 million square meters (NHS England, 2023a). However, 18% of these facilities are older than the NHS itself, and 43% are over 30 years old (Short et al., 2014). Many facilities are outdated and underutilised, with a maintenance backlog reaching £10.2 billion in 2022, an 11% increase from the previous year, and over half of the issues were deemed 'high' or 'significant risk' (NHS Digital, 2023).

Built asset management is the process by which buildings are maintained and refurbished throughout their life cycle (BS 8210:2020), as all buildings become obsolete over time (Butt et al., 2015). Following the occupancy of a newly built asset, its performance begins to deteriorate due to wear and tear on the fabric and building services, as well as changing demands resulting from external drivers (e.g., climate change) and user expectations. Routine maintenance, whether responsive or preventative, generally aims to return the built asset to its original performance level, whilst refurbishment seeks to improve the performance of the built asset beyond its original specification to address the obsolescence gap (Jones and Sharp, 2007). However, the current methods to identify upgrade strategies do not fully meet hospitals' needs. In the UK, hospitals, as public sector strategic built asset management, generally follow the guidance provided by the Royal Institution of Chartered Surveyors (RICS 2021). According to RICS (2021), the goal of strategic asset management is “[...] *the activity of aligning property assets with the strategic aims and direction of the organisation and adding both financial and non-financial value to the organisation as a result*”. To achieve this goal requires hospitals to have clear strategic goals that identify the organisation's direction of travel and for these to be expressed in such a way that allows the facilities manager to evaluate the degree to which the performance of the physical, human, financial, cultural and informational processes and systems performance of the current built assets (the Estate) can meet these strategic goals and add value to the organisations. In making such assessments, Facilities Management (FM) professionals must anticipate how change drivers will impact performance levels throughout the estate's life cycle (Pascale and Jones, 2023) and also develop interventions that can be implemented over time to manage these changes effectively.

Desai and Jones (2010) noted that while the discussed approach aligns with global best practices, practical issues arise in translating it into operational tools. They highlighted that an organisation's institutional memory can hinder innovative thinking, limiting FM professionals' ability to consider radical changes necessary to address future demands, especially during significant shifts. To address this issue, Jones et al. (2015) suggested that FM professionals abandon the traditional forecasting method of strategic built asset management, which typically ties current planning to maintenance and refurbishment schedules. Instead, they advocated a Participatory Backcasting (PB) approach, in which future performance goals are established first. From there, alternative maintenance and refurbishment plans are evaluated by moving backwards in incremental time steps from those future goals to the present, minimising the impact of current trajectories on planning and increasing the likelihood of achieving future performance objectives. However, when dealing with the NHS estate, Estate and Facilities Management (EFM) team can face notable barriers in the journey towards creating a future sustainable and climate-resilient hospital estate, mainly due to estate management, financial aspects, and organisational development, which may develop biases that hinder the EFM's ability to set long-term estate goals and anticipate the effects of change drivers like sustainability and climate resilience (Pascale and Jones, 2025). The current paper aims to contribute to the debate by discussing the experience of using PB in a research project focused on developing a framework that can provide hospitals with integrated mitigation strategies to transition to a zero-carbon future by 2050, as well as adaptation strategies to address existing climate change through better-informed facilities and built asset management planning. The paper presents the outcomes of two workshops conducted with the Estate and Facilities Management (EFM) team of an NHS trust in England to translate the holistic vision of future sustainable and climate-resilient hospital estates in 2050 presented in Pascale and Achour (2024) into specific performance criteria for an existing hospital estate in terms of SMART objectives and KPIs.

Challenges in defining strategic goals to identify the NHS trusts' directions of travel towards a sustainable and climate-resilient estate

With the Health and Care Act 2022 (Department of Health and Social Care, 2022), the NHS in England aims to become a net-zero-carbon healthcare system. To achieve this, the NHS's carbon footprint and pathways to net zero were published in NHS 'Delivering a 'Net Zero' National Health Service' (NHS England & NHS Improvement, 2020). In 2022, NHS England also published the Net Zero Carbon

Hospital Standard (NHS England, 2023b), which provides a roadmap for reducing operational building energy demands, embodied carbon in construction and the whole-life carbon of building elements used within them. However, “the standard mostly covers aspects related to the construction of new healthcare buildings and has less focus on mitigation actions related to building refurbishment” (Amamou et al., 2025). The Health and Care Act 2022 requires NHS trusts to develop Green Plans outlining essential actions to reduce emissions and enhance resilience to climate impacts over the next three years (NHS England, 2025). However, while the guidance for creating Green Plans mandates that trusts define Specific, Measurable, Achievable, Relevant, and Time-bound (SMART) targets and the associated Key Performance Indicators (KPIs) for each focus area, there are limited metrics available for decarbonising the estate, and none related to climate resilience, which is reflected in the actual Green Plans.

In an analysis of 181 publicly available Green Plans, Amamou et al. (2025) found that KPIs were mentioned in only 11% of them. Of these, 15 trusts explicitly listed the KPIs they are using to track the estate's progress. In addition, they identified that “even where trusts have identified KPIs, a common issue is the confusion between performance indicators, metrics, and targets”, with only five trusts having specific, measurable and time-bound values as KPIs, and only one trust reported to have developed SMART objectives. Amamou et al. (2025) noted that trusts struggle to upgrade old buildings to meet net-zero standards. While Green Plans set carbon-reduction and energy-efficiency goals, they lack detailed long-term monitoring strategies to assess building performance during and after refurbishment. Following the 2008 Climate Change Act, NHS trusts are also required to adapt to the impacts of climate change. However, the NHS's current approach primarily focuses on mitigation strategies to reduce the environmental impact of its facilities. Therefore, there is a lack of emphasis on adaptation strategies, which are essential for reducing vulnerability and risks associated with climate change and strengthening resilience in rapidly changing healthcare systems (Pascale and Achour, 2024).

BACKGROUND

Participatory backcasting is a methodology for long-term planning that includes the development of a desirable future vision, followed by backcasting analysis to elaborate a pathway towards this vision and, if required (Quist, 2007; Jansen, 2003; Robinson, 1982). It is characterised by the involvement of a broad range of stakeholders, a long-term orientation, normativity, and a consensus-building orientation (Robinson, 2003; Green & Vergragt, 2002). Backcasting has been proposed as a sustainable alternative to traditional planning and a tool for pursuing alternative futures in the face of climate change (Giddens, 2009). It is regarded as effective in uncertain environments with complex systems and undesirable current trends, making it beneficial for driving the system-level innovations necessary to change these trends. Its multidisciplinary approach is well-suited for addressing sustainability issues (Köves et al., 2021). Backcasting is viewed as a natural tool for implementing sustainable development throughout society due to its normative and problem-solving characteristics (Bibri, 2018) and its capacity to envision and analyse various types of sustainable futures while developing agendas, strategies, and pathways to achieve them (Vergragt & Quist, 2011). However, most previous studies have focused on mitigation interventions related to the energy sector and greenhouse gas emission trajectories at the national, regional or city scale (Francart et al., 2018; Zivkovic et al., 2016; Green & Vergragt, 2002; Robinson, 1982), with a limited number of studies focusing on the need to implement adaptation strategies to climate change (Bruley et al., 2021; Mendizabal et al., 2021; van der Voorn et al., 2012). In addition, a limited number of studies assess mitigation or adaptation interventions that are actionable at the building level and do not consider the implications and challenges posed by the proposed interventions for existing buildings (Francart et al., 2018; Hurmekoski et al., 2018; Doyle & Davies, 2013).

To the best of the authors' knowledge, the research presented in Jones et al. (2015) is the only application of backcasting in built asset management to address future climate change. Jones et al. (ibid) articulated their research in a series of workshops, starting with the definition of future building

expectations and then establishing specific performance criteria against which alternative adaptation options could be evaluated. Jones et al. (ibid) conclude that backcasting can help implement significant changes in built asset management to address future climate change. However, PB studies can present challenges. Doyle and Davies (2013) reported that participants preferred discussing broader issues instead of focusing on technical solutions, while Sandström et al (2020) remarked that “the stakeholders tended to get stuck in the politics of the day and specifically how current policy dilemmas should or could be handled. There is certainly no disadvantage in including discussions of these present time dilemmas, but it may, to some extent, hamper the intended principal discussions on innovative solutions”. Lundgren et al. (2024) found that technical stakeholders struggle in the backcasting exercise as the urgency they perceive in the transition tends to make them focus solely on immediate tasks, causing them to overlook long-term planning. In addition, it is reported that stakeholders find it difficult to distinguish between goals and measures (Toivonen et al., 2021; Sandström et al., 2020). Luhas et al (2021), while acknowledging that dealing with complex issues in a limited timeframe of group discussions is challenging in practice, suggest that a clear structure for scheduling could help to dedicate sufficient time to discuss all the specific steps in similar depth, and providing instructions related to group discussions for the chair can help fulfil sufficient discussions and to prevent irrelevant topics. Therefore, further research is needed to determine whether workshops organised with well-timed, structured activities can help overcome these challenges.

METHODS AND DATA

The research presented in this paper is part of a larger project utilising PB working in partnership with a NHS trust case study in Southeast England. This research follows the process by Quist and Vergragt (2006) and adapted by Jones et al. (2015) for built asset management, which includes five steps: 1. Problem orientation; 2. Construction of future visions and scenarios; 3. Backward analyses; 4. Definition of action plans; and 5. Implementation and embedding results. The findings presented in this paper focus on constructing future visions and operational scenarios. In the project's first step, a scoping study was completed to identify the driving changes for the hospital of the future, and strategies implemented or auspicated within these areas for the past 20 years have been identified and evaluated (Pascale & Jones, 2023). In the second step, a workshop was undertaken with a wide range of stakeholders working for or involved with the NHS trust case study to develop a holistic vision of the future, sustainable and climate-resilient hospital, as presented in Pascale & Achour (2024). The changes related to the hospital estate were associated with three main components as reported in Table 1.

Table 3 Aspirational targets for the future hospital estate (adapted from Pascale and Achour, 2024)

Areas	Components	Aspirational Targets
Hospital estates	Climate Resilience	Climate change adaptation
		Organisational resilience
		System resilience
	Sustainability	Net Zero Carbon
		Active travel networks
		Circular economy model
	Salutogenic design	Comprehensible spaces
		Manageable spaces
		Biophilic and healing hospital design

This paper presents the results of the two following half-day workshops aimed at translating the holistic vision of the future sustainable and climate-resilient hospital estates in 2050 presented in Pascale and Achour (2024) into specific performance criteria for an existing hospital estate in terms of SMART objectives and KPIs and identifying barriers and opportunities for achieving that vision, the latter presented in Pascale and Jones (2025). A multi-disciplinary team of 14 participants with technical

expertise, including members of the NHS Trust case study's estate and facilities team, as well as their consultancy team involved in the decarbonisation and climate resilience interventions and representatives from research and academia, contributed to the two workshops (See Table 2).

Table 4 Workshops participants grouped by area of expertise and profession. The figure in brackets represents the number of participants per profession. Source: Authors' own work.

Workshop representative from EFM at the NHS trust case study	Workshop representative from the consultancy team for the NHS trust case study	Workshop representative from Research and Academia
Capital Project Management (2)	Quantity surveying (1)	Healthcare sustainability and resilience (1)
Estates Strategy and Planning (1)	Building Services Engineering (1)	Engineering (1)
Sustainability Management (2)	Architecture (1)	Digital Technology (1)
Specialist Services (1)		Passivhaus Design (1)
		Quantity surveying (1)
		Facilities and Estate (1)

The participants in these two workshops were different from those who developed the holistic vision for the future hospital. Therefore, the first workshop was designed to help participants become familiar with the aspirational targets and to understand their level of decision-making power regarding these targets and how they aligned with the trust's current and future strategies. To achieve these aims, the lead researcher organised and facilitated the workshop. Activities were structured so participants could work in groups and engage in independent discussions. They collaborated in interdisciplinary teams and used flipcharts and Post-it notes to organise their ideas. They were also asked to prioritise the aspirational targets in order of importance against control (using a scale that went from 0 – Absolutely not important/controllable to 5 – Highest importance/control) and rank the hospital's current and future performance in relation to the success factors (using a scale that went from 1 – Poor to 5 – Outstanding) and rank the hospital's current and future performance in relation to the aspirational targets (using a scale that went from 1 – Poor to 5 – Outstanding) using the software Mentimeter. During the second workshop, participants engaged in activities to turn aspirational targets into SMART objectives and KPIs aligned with the hospital's vision. Participants were explained the meaning of SMART objectives and the need to define KPIs to allow for monitoring and measuring success. To complete this task, the research team had initially planned to ask the participants to individually produce cards on which to write SMART objectives related to each aspirational target about the estate, present the developed ideas to the other members of the group, discuss all the group's suggestions, and then vote for the top ideas. After that, participants should have produced a group poster of the most valuable and feasible ideas, SMART objectives, presented each group's poster and explained their topmost viable and valuable SMART objectives to the other groups, and voted for the overall 'top SMART Objectives'. However, this plan had to be set aside as the participants struggled to develop specific targets. Consequently, participants engaged first in an interdisciplinary group discussion to identify the targets and subsequently in a plenary debate. During both workshops, the activities were audio recorded. A thematic analysis using the six-phase analytical process supported by NVivo version 14 (Braun et al., 2012; Nowell et al., 2017) was conducted to analyse the results of the two workshops.

RESULTS

Importance versus control of the aspirational targets and analysis of their current and future performance

Figure 1 reports the average significance and control level for each aspirational target related to the estate. The reasoning behind the ranking is presented, as provided by participants during the workshop, for various aspirational targets across the three components — "Climate Resilience," "Sustainability," and "Salutogenic design".



Figure 1 Control vs. Importance Matrix for the aspirational targets. Source: Authors' own work.

Climate resilience. Climate change adaptation and system resilience were viewed as high priorities, while organisational resilience was considered less significant in 2050. This assessment was based on the belief that work in organisational resilience would already be completed by that time. In contrast, climate change adaptation and system resilience were regarded as targets hospitals might not fully achieve by 2050, even if society strives toward a more sustainable future. Regarding climate adaptation, whilst participants clearly expressed the need for new hospitals in the next 20 years, designed based on updated weather parameters, further reflection on how to approach the existing estate was also described as the real challenge. This was due to the nature of the existing estate and the extent of the funds required. It was also ascribed to a lack of a proactive adaptation strategy and the fact that interventions were undertaken in 'small doses' and not in a cohesive manner. As the estate comprises a diverse portfolio of buildings of varying ages and types, a detailed assessment of the existing estate by mapping vulnerable areas across the trust was repeatedly presented as a priority. Understanding the system's resilience was necessary, as participants viewed the hospital as part of a complex, extensive healthcare system. However, the significant concerns regarding achieving this target were the amount of funds needed to improve primary and social care to enable fully integrated care provision, convert hospitals into hybrid institutions, and improve the physical and digital infrastructure to reduce reliance on other critical infrastructures.

Sustainability. While Net Zero received one of the highest importance scores, the control score was lower. There was a view that existing hospitals would never reach net Zero carbon without significant offsetting, due to constraints imposed by their footprint and height. This was mainly due to power generation issues. In addition, there was a strong need for hospital leadership to be on board to make the transition to a sustainable hospital possible, whose strategic choices depended on the availability of funds rather than long-term strategic planning. Regarding active travel networks, participants considered hospital control to be very low, as other players and infrastructure were needed to implement them. In addition, the low importance score achieved can be explained by the contrasting points of view expressed by the participants. It was described as "very important" for hospitals in urban contexts but unfeasible for hospitals in rural areas, as cars were described as the only solution. The circular economy was considered necessary, mainly because of its links with the reuse and adaptation of hospital buildings.

Salutogenic Design. The three targets in this area were considered only of moderate control because, in the current state of the NHS, these categories were not considered a priority for public hospitals. However, their importance was recognised, as participants emphasised the need to improve wayfinding in hospitals, which are complicated to navigate, even for staff. However, why was this considered feasible within a new hospital? “With existing environments where you kind of restricted in the ability to simplify that, you’ll be relying on technology and applications” Workshop Participant (WP). While some participants defined nature-based hospitals as “nice but not important,” others noted their importance for air quality and their positive impact on diversity, net gain, and patients. However, they were considered difficult to achieve because of the current demand for hospital estates and the building typology, which multi-storey hospitals dominate.

Transform the aspirational targets into SMART objectives

Participants struggled to define the SMART Targets as summarised in Table 3.

Table 5 Thematic analysis regarding translating aspirational targets into SMART objectives for the existing estate

Areas	Components	Aspirational Targets	Discussion related to SMART objectives
Hospital estates	Climate Resilience	Climate change adaptation	Participants considered performance criteria that could measure performance against the norms: “So there are national norms for overheating and some of them are compliance-based. So the targets should reflect on those external drivers somewhere” (WP). Participants discussed the number of overheating days, the number of low air quality and how to start monitoring them. Participants also discussed how to measure the associated risks and systemic risk modelling: “ [...] and how the risks from one system affect other systems and whether the trust had done any systemic modelling at that level or whether their risk registers were still very much siloed around the individual activities or delivery. Maybe a metric around there would be to try to move towards integrating those risk values in some systemic way to try to sort of identify the weak, weakest link in the system” (WP).
		Organisational resilience	The long-term clinical strategies were seen as an opportunity to develop and implement performance criteria to address clinical and estate needs. The trust was currently working on a list of divisional plans that needed to be addressed for urgency, affordability, and feasibility from the estate and Human Resource (HR) perspectives: “ [...] and obviously, we’re looking at it through the estate’s lens and what that means for our buildings. What does that mean for our power infrastructure? HR teams and others are looking at what that means for our staffing model and that sort of thing. So it’s huge!” (WP).
		System resilience	Regarding system resilience, participants had a broad discussion on the role of decentralisation in healthcare and digitalisation. In particular, they discussed the benefits of an integrated care system where care is moved from hospital to community to free up space in hospital buildings: “We could then potentially move some people into the ICS boundary in community settings and not on our acute site, allowing us to free up buildings, which are really end-of-life” (WP). However, they mentioned the opposition of the clinical staff towards this move. They also discussed the role of this scenario of centralising Electronic Patient Records (EPR).
	Sustainability	Net Zero Carbon	Regarding the Net Zero Carbon target, participants mentioned the national targets set in the ‘Delivering a ‘Net Zero’ National Health’ and those set by the Trust in their Green Plan. However, they acknowledged that these targets were not SMART in their current form. Participants discussed the need not just for high-level metrics but also for more granular metrics. They discussed the idea of a retrofit threshold and asked: “How do you make a decision? Is it purely a cost-benefit or cost-return? And if it is, what are your thresholds? Is it a 1 to 1? Is it a 1 to 2?” (WP).
		Active travel networks	(Not discussed as considered of Very low Control – Moderate Importance)
		Circular economy model	Different suggestions were made to turn the circular economy into performance criteria, such as supply chain miles, to examine prequalification. Participants also discussed thresholds: “Where’s your limit, and how do you balance that against cost?”
	Salutogenic design	Comprehensive/Manageable spaces and Biophilic and healing hospital design	Participants discussed the three targets together as they related to patients’ health metrics, such as improved mental or physical health and reduced medication use. Reducing staff sick days was also discussed.

DISCUSSION

The current paper presents the outcomes of two workshops organised to translate the holistic vision of future sustainable and climate-resilient hospital estates in 2050 presented in Pascale and Achour (2024) into specific performance criteria for an existing hospital estate in terms of SMART objectives and KPIs, following the PB methodology presented by Quist & Vergragt (2006) and adapted by Jones et al. (2015). Since these stakeholders were different from those who had developed the holistic vision of the hospital of the future and the researchers were conscious of the challenges experienced in similar types of research (Sandström et al., 2020; Doyle & Davies, 2013), the first workshop was designed to help participants familiarise themselves with the aspirational targets, while the second workshop focused on transforming these targets into SMART objectives and KPIs. However, despite the fact that structured activities and scheduling were organised to dedicate sufficient time to discuss all the specific steps in a similar depth, and instructions were provided to the group moderator to facilitate the group discussions, the stakeholders from the NHS Trust case study's estate and facilities team, focused their discussions centred on the challenges (estate management, financial aspects, and organisational development) that hinder their ability to act (Pascale and Jones 2025), as also experienced by Sandström et al. (2020). In the first workshop, all targets for the hospital estate—except “Active Travel” and “Organisational Resilience”—were considered highly important. However, participants rated their level of control over these targets mainly as 'Moderate', with 'Active Travel' rated 'Low'. This raises questions about the role of EFM within the hospital trust's leadership structure, particularly since many of these targets fall within EFM's remit. It also reflects a broader lack of strategic planning, with decisions often driven by funding availability rather than long-term objectives. In addition, there was a remarkable focus on contingent, immediate tasks, such as mapping vulnerable areas, which hindered their ability to consider long-term objectives, as also described by Lundgren et al. (2024).

During the second workshop, despite participants' expert and technical backgrounds and the structured activities planned, they struggled to translate the aspirational targets into SMART objectives and related KPIs. Therefore, as also experienced by Doyle and Davies (2013), the conversation became general on “*what might a target look like?*” During the discussion, it was clear that participants struggled to distinguish between objectives and measures, as also experienced by Toivonen et al. (2021) and Sandström et al. (2020). However, the difficulty in defining SMART objectives and KPIs for the green transition and the struggle to upgrade old buildings to meet net-zero standards is widespread among NHS trusts (Amamou et al., 2025). Only 11% of 181 publicly available Green Plans mentioned KPIs; among these, only 15 trusts listed their KPIs, only five had specific, measurable, and time-bound values, and just one trust reported SMART objectives (Amamou et al., 2025). Participants also discussed the need for both high-level and granular metrics to assess building performance during and after refurbishment. However, a profound confusion emerged between performance indicators, metrics, and targets during the workshops, which aligns with the findings of Amamou et al. (2025). Developing SMART objectives for climate adaptation was also challenging due to the perceived need to link these risks to systemic risk modelling, as well as the lack of emphasis on adaptation strategies in the NHS (Pascale & Achour, 2024).

CONCLUSIONS AND FUTURE WORK

Shifting from traditional forecasting linked to current maintenance schedules to PB approach can minimise the influence of current practices and enhance the likelihood of achieving future objectives, as this method involves establishing future performance goals first and then evaluating maintenance plans by working backwards. While the application of PB to mitigation or adaptation issues at the national, regional, or city scale is feasible within a holistic vision of the future, studies to develop actionable mitigation or adaptation interventions at the building level require translating that vision into specific performance criteria. However, the current research demonstrates that this exercise is challenging, even for stakeholders with expert and technical backgrounds, when conducted in well-timed and structured activities. In the case of hospital EFM professionals, issues related to the role of

EFM within the hospital trust's leadership structure, lack of strategic planning, with decisions often driven by funding availability rather than long-term objectives and a tendency to focus on contingent, immediate tasks, can hinder EFM professionals' ability to disconnect from the daily challenges and consider long-term objectives. In addition, the lack of centrally developed guidelines on the SMART objectives and KPIs associated with the greening agenda is a barrier to identifying performance criteria for the existing estate. Therefore, applying BP with EFM professionals may require new methodological enquiries to co-create effective data collection activities that consider the power dynamics within trusts and meet stakeholders' knowledge and expectations.

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Temporality to Promote Circularity in the Real Estate Sector

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ABSTRACT

Background and Aim. Economic, demographic, and other societal fluctuations leave many buildings vacant due to locational obsolescence. Maximizing the use of existing buildings would foster a shift toward circularity and resource efficiency. This paper explores two lesser known, creative circular strategies for asset and facility management.

Methods and Data. Employing futures studies methods, we imagine two circular futures: 1) relocating buildings has become standard practice 2) all vacant facilities are efficiently used, even during transitional times. We organize two backcasting workshops to explore which political, economic, social, technological, and environmental developments need to take place for the futures to realize.

Results. Our findings identify necessary actions toward the two circular futures to sustain our planet's finite resources. Suggested actions range from adjusting lifecycle assessment and real estate valuation practices to creating mediator and advisory roles and related business models. Educating young professionals on these practices is also seen necessary for the transition.

Originality. Engaging in futures studies in facility management research is still rather uncommon. Further, temporality as a circular strategy to tackle locational obsolescence is underexplored.

Practical Implications. This study contributes to the emerging bodies of knowledge of both circular FM and future awareness in FM. We offer insights for policy makers, educators and facility management professionals as they undergo the transition towards circular practices.

Type of Paper. Full Research

KEYWORDS. backcasting, circular FM, relocation, resource efficiency, temporary use

INTRODUCTION

Due to its significant role in global resource extraction, waste production, energy consumption, and carbon emissions, the building sector is in dire need of a sustainability transition and would benefit from the use of circular practices. Within circularity, current efforts often focus on new construction and circular materials. However, recent advances in circular thinking have placed more focus on retaining value in the system and more efficient circularity measures, such as the efficient use and management of the existing building stock (Bellini et al., 2025; Jensen & Nielsen, 2024; Kyrö & Lundgren, 2023). Meanwhile, economic and demographic fluctuations leave buildings vacant due to locational obsolescence, i.e., buildings being devalued due to the context of their current location (Pinder & Wilkinson, 2001). Avoiding demolition of obsolete buildings and replacement through new construction elsewhere is desperately needed. Retaining buildings means preserving value already tied to them, reducing resource consumption, embodied energy and emissions, and maintaining cultural heritage.

Two alternative circular strategies, namely, temporary use and relocating buildings, specifically respond to locational obsolescence. Circular economy is traditionally linked to durability and prolonging lifecycles. Thus, at a first glance, two practices stemming from temporality may seem almost contradictory to circularity principle. However, both strategies stem from the need to

accommodate demographic and other societal changes and aim at continued use of an existing building, rather than demolishing and constructing new. The two strategies also share disadvantages, such as poor reputation as less desirable and attractive, and even their respective user groups may be considered disadvantaged. Consequently, it is worthwhile to study the common paths towards a wider adaptation of temporary use and relocating buildings as circular practices. Previous research on temporary use has focused on processes, collaboration, social and political aspects, and regulations (Armstrong et al., 2024; Bishop & Williams, 2012; Galdini, 2020; Hernberg, 2022; Kawa, Van Schoor, et al., 2024; Madanipour, 2018; Matoga, 2019; Oswalt et al., 2013; Patti & Polyak, 2015; Senatsverwaltung für Stadtentwicklung Berlin, 2007; Tonkiss, 2013; Zhang, 2018). Although temporary use of vacant buildings has a long tradition, the possibilities as a circular practice are only emerging. Temporary use of vacant buildings has been highlighted as a sustainable practice by Armstrong (2023), as a resource efficient practice by Hernberg (2022) and as a circular practice by Mazzarella (2025). Mazzarella and Amenta (2022) note that the socio-environmental regeneration of wastescapes, i.e. urban spaces in between development, is necessary in the transition toward circularity.

Similarly to temporary use, relocatable buildings may temporarily occupy land that is currently vacant, perhaps awaiting long-term development plans or the like (Glumac, 2021). Relocating static buildings has been done e.g. in connection with environmental crises, such as a town collapsing due to mining (Kyrö & Lundgren, 2024). However, this paper focuses on buildings intended to be relocated. The use of relocatable buildings, mainly in the form of modular units that can be added together to fit the specific needs of certain users, is commonplace. Particularly in the public sector relocatable buildings are widely used for daycare, schools, or healthcare purposes, as a response to demographic shifts. When combined with a space-as-a-service (leasing) model, relocatable buildings allow for further flexibility in real estate portfolios (Adapteo, 2025; Clough, 2022; Kyrö et al., 2017, 2019; Vihola & Edelman, 2016). The practice of relocating buildings has been noted to be circular in academic literature by (Kenttälä et al., 2025; Kyrö et al., 2017, 2019; Kyrö & Lundgren, 2023). Providers of relocatable, leased buildings have been recognized to be circularity pioneers by the World Circular Economy Forum (Parmaco, 2024; World Circular Economy Forum, 2024). Additionally, advancing circularity in modular construction has been studied by Wuni & Shen (2022) and De Silva et al. (2025).

Despite these recent advancements, temporary use of existing buildings and relocating buildings as circular strategies have received only limited attention in academic literature. This paper therefore sets out to study temporary use and relocation as circular practices together, exploring the common challenges to their implementation and actions needed to promote them. Moreover, despite recent advancements (Ghalandar et al., 2023; Lundgren et al., 2024; Pascale & Jones, 2023), futures studies methods within facility management research are still rather uncommon. Thus, the methodological aim of this paper is to employ a futures studies method called backcasting for facility management research. Subsequently, this study contributes to the emerging bodies of knowledge of both circular FM and future awareness in FM.

The paper is structured, as follows. The next section introduces existing knowledge on the two examined circular futures. The following section introduces the research design, including method, data collection, and analysis. After that, the results of the two workshops are presented separately. The Discussion section synthesizes the findings with a cross-analysis and comparison to existing knowledge. Conclusions end the paper with final thoughts and suggestions for further research.

LITERATURE STUDY

This section presents existing knowledge on the two circular strategies under research, namely, Temporary creative use and Relocating buildings. The focus is on the definition and origins of the concept and practice, as well as the perceived benefits and potential challenges.

Temporary creative use

Temporary use is not well-defined but entails the basic idea that a space which is in an in-between stage, e.g. during a city zoning process, waiting to be redeveloped, is taken to use. The timeframe of temporality is likewise unclear and could range from a month to a decade or more (Hernberg, 2022). From the circular economy perspective, temporary use is one way to respond to disruption in spatial functions and needs (Kyrö & Lundgren, 2024). Due to its potential for fostering a maker-culture, projects are typically end-user driven and entail creative uses (Hernberg, 2022; Kawa, Galle, et al., 2024; Kyrö & Lundgren, 2024). However, due to the recent workplace transition and increasing office vacancies in central business districts, also other types of temporary use have emerged. In an Australian context, a toolkit for temporary use, the Sustainable Temporary Adaptive Reuse (STAR) toolkit focuses on the possibilities of short-term leases of vacant offices. Besides creative use, such as art galleries, opportunities are noted in e.g. pop-up retail stores. The practical toolkit covers issues such as planning processes, communication, and governance regulations (Armstrong et al., 2024).

The known advantages and opportunities of temporary use comprise the inclusion of underprivileged community members in bottom-up initiatives, new urban functions, embracing uncertainty and change, implementation of circular practices, waste reduction, and even boosting of the local economy (Kawa, Van Schoor, et al., 2024; Madanipour, 2018; Matoga, 2019; Patti & Polyak, 2015; Zhang, 2018). Meanwhile, key identified challenges include the power relations and involvement of private and public actors, the vulnerability of certain actors, the risk of instrumentalization, gentrification, historical contradiction and identity, and administrative obstacles. A further challenge is how short-term use affects the handling of materials and investment insecurity (Kawa, Van Schoor, et al., 2024).

The focus in research on temporary (re)use of existing buildings has increasingly been directed from a building-focus to a people-focus (Galdini, 2020). Based on an Italian context, Galdini (2020) points out that such practice should not be considered “occasional or random” and elaborates on the potential of temporary use of vacant buildings not only to re-shape space, but also to nudge governmental, urban regeneration work in the direction of a more integrated process, where citizens are actively involved. Awareness regarding the necessity and importance of mediators in the collaborative development processes is increasing, while the role has long been taken on by planners and others – perhaps less consciously or orderly, and often without proper training (Hernberg, 2022). Patti & Polyak (2015) found that the need for enhancing the connection between public policies, and citizen and community initiatives, is a common challenge regardless of context (Patti & Polyak, 2015).

Relocating buildings

Relocatable buildings may be either transported as complete units or transported in modules and assembled onsite. The latter are more flexible and even customizable. A common trait is that both types are largely produced off-site before onsite installation (Clough, 2022). Relocation of complete buildings has a long history, one example being the relocation of single residential houses in the U.S. (Gamble, 2024). The use of modular buildings and elements equally has a long history, e.g. in reacting to urgent and extreme situations, such as wars.

Kyrö et al. (2019) argue that the logic of relocatable buildings fits well with that of the circular economy principles, keeping products in a closed loop of use and reuse for as long as possible. In addition to environmental and resource efficiency, e.g., the reduction of construction waste and transport of materials to the building site (Clough, 2022), a primary advantage is the time-saving aspect. Factory-made units can be rented or purchased, used or reused almost instantly and for a wide range of functions, e.g. for schools and in health care (Clough, 2022; Gamble, 2024; Vihola & Edelman, 2016). The quality of the facilities is enhanced, as they are produced in a controlled environment (Vihola & Edelman, 2016) and the reuse process can be a “clean” process, when the building is designed for deconstruction and relocation (Bertino et al., 2021; Gamble, 2024). The units can be held technically up-to-date and enable rapid response to changing needs and technical requirements, thus presenting a satisfactory solution to users, i.e. staff and clients in the case of Clough (2022) and Kyrö et al. (2019).

From the perspective of public sector facility management, relocatable buildings, especially when leased, allow for flexibility in their real estate portfolio, and enable responding to future demographic situations (Kyrö et al., 2017; Vihola & Edelman, 2016). Vihola & Edelman (2016) conduct comparative lifecycle costing analyses of a relocatable and a traditional building and find that, although the lifecycle costs of leasable modules are higher than that of traditional building, they come with significantly lower initial investment costs and no risk of ownership. This, combined with the gained flexibility in the real estate portfolio, make leased relocatable school buildings a viable option for municipalities (Vihola & Edelman, 2016). Moreover, faster on-site construction and installation save labour costs and eases the negative impact on the community during construction (Chen, 2023).

The attractiveness and acceptance of relocatable buildings is often lifted as a challenge, yet both Glumac (2021) and Kyrö et al. (2019) find a generally positive attitude. Still, a lack of siting and landscape qualities caused by the temporary placement (Edelman et al., 2016) and the limitations in architectural features (e.g. too simplistic volumes and design, visual appearance), manufacturing, and logistics (Kyrö et al., 2019) are typical challenges for relocatable buildings. The question of responsibility for the end-product is another aspect worth considering (Edelman et al., 2016). A collaborative process and customization of the buildings can aid these issues, however, trumps the benefits related to time efficiency (Edelman et al., 2016; Kyrö et al., 2019). By involving different stakeholders in the early design process, the process can be optimized (Kyrö et al., 2019).

METHODS AND DATA

This research engages in futures studies. Futures studies is a multidisciplinary research field focused on anticipation and foresight. Futures studies methods have great variety and may be applied to any topic of study, typically with the purpose of supporting decision-making (Heinonen et al., 2017). While quantitative scenarios based on current and historical data are a type of future studies, the future itself cannot be empirically studied as data cannot be collected from the future. The inherent uncertainty of futures studies makes the field most suitable for exploratory studies aiming at novel insights and viewpoints.

The study at hand employs a qualitative futures studies method called backcasting. Backcasting explores how a certain, pre-determined future could be reached (Börjeson et al., 2006). Backcasting is especially suited for studying preferable futures. Preferable futures may also be referred to as desired futures, or “visions” (Alexander, 2009). They are normative futures which always entail a value judgement, e.g., sustainable futures. Sustainable futures are often complex and may benefit from a systematic breakdown of individual aspects (Holmberg & Robert, 2000), which holds true for this study as well. The prominent idea in backcasting is to move back from the predefined, preferred future to the present, with the intent to identify what changes would have occurred in between. The main benefit of the method is to set the participants free from the current state of things, leading to some undesirable probable future, e.g. environmental crises. Backcasting is even said to be more of an attitude than a method, as it is an attempt to break away from the current development which is failing to reach a desirable future (Höjer & Mattsson, 2000).

Two 2-hour workshops were held online in March 2024. Each workshop included three to four experts in the respective theme. The experts represented academics, public officials, and industry from Sweden and Finland. Their expertise was in the fields of architecture, culture, and sustainability. Each participant was asked for consent to participate in the research and record the sessions. Each workshop focused on one preferable future. To provoke the participants thinking, pictures for these future images were created with Bing AI (see Figure 1a-b), and an accompanying text description was created with Chat GPT. The generated text was checked and edited by the authors before sharing with the participants.

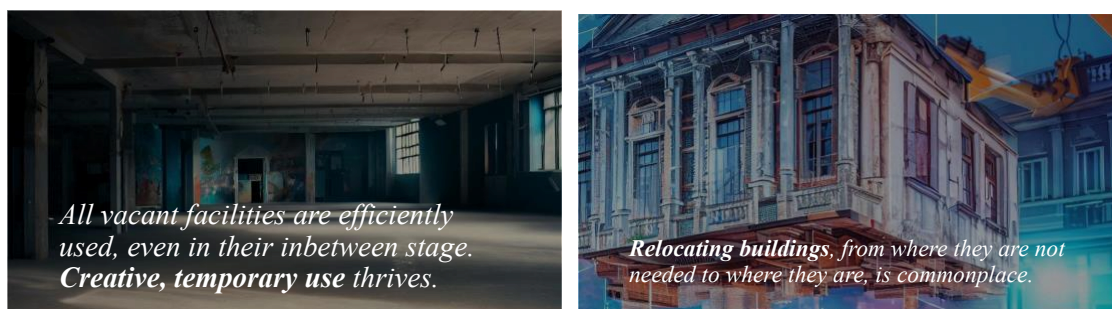


Figure 1a-b Illustrations of futures images presented to workshop participants. Source: Authors using Bing AI.

A collaborative digital whiteboard was used as a tool to collect ideas for needed actions, and the participants were instructed to use the PESTE framework as a tool to organize ideas. PESTE is a useful tool for future-oriented strategy work of organizations (Haynes et al., 2017). PESTE stands for Political, Economic, Social, Technological, and Environmental. Sometimes another category, Legal is added to the framework, however, quite often the regulatory aspects are incorporated into the 'Political' category. PESTE has previously been used for categorising future impacts with the FM field (Alexander, 2009). The original categorisation was checked and partially altered during the analysis process, as the output was analysed thematically, likewise using PESTE. The thematic analysis focused on identifying patterns, but also outliers in the data for each category. Both workshops were analysed separately, before a cross-analysis.

RESULTS

This section presents the key findings from each workshop, categorizing the findings using the PESTE. Following, the findings are synthesized in a table and cross-analyzed for the Discussion section.

Relocatable buildings

Political. Suggested actions include restricting building permits for new construction in favour of relocation and reuse. Temporary building permits for relocatable buildings to expedite their deployment was also suggested. As cities and municipalities are already using relocatable buildings to mitigate fluctuating demographics, a suggested action was to extend this practice to the private sector and commercial buildings. As a more radical action, it was proposed that all new buildings should be required to be relocatable. It was also suggested that urban planners should shift from targets in area of square meters, to meeting needs through function and quality.

Economic. Incentives were proposed to enhance circularity, such as tax benefits for rehabilitation and relocation projects, subsidies for relocation, and special funds for free consultancy on reuse and relocation projects. The feasibility of relocation and rehabilitation projects was also considered. While these projects can be presented as affordable options, certain changes are necessary. Shifting the focus in lifecycle profit assessments from technical life to functional life is crucial, as the technical life is seldom realized due to locational or functional obsolescence. The valuation of real estate should also be revised to accommodate relocatable buildings, equating them with traditional buildings.

Social. The transition of the real estate and construction industry, even the elimination of the traditional new construction focused industry, was lifted as a rather radical action by the participants. Education was highlighted as a key action in transitioning the sector. Changing the perception of relocatable buildings being of a poorer standard than a regular building was also seen as a crucial step. Actions to increase social awareness of the possibility of relocatable buildings being of equal quality to regular buildings was seen as necessary for increased uptake.

Technical. Actions related to training were highlighted. Training new engineers in future-fit solutions, rather than outdated technologies and obsolete methods, will produce a new generation of engineers capable of devising smart and feasible solutions for relocating structures. Further, all other

practitioners involved in the process such as architects and carpenters were deemed to require the same upskilling.

Environmental. Using materials with low environmental impact was discussed as one way to further improve relocatable buildings. This was considered to bring the relocatable buildings in line with current sustainability trends in the sector and might therefore be picked up in environmental assessments. Developing a specific green building certification scheme for relocatable buildings was also suggested as a way to improve the visibility of the environmental benefits of relocatable buildings and make them equal to regular buildings.

Temporary creative use

Political. A key action would be a more relaxed approach to temporary uses in city zoning. Zoning practices need to be revised to better accommodate changes in building usage, thereby enabling creative temporary uses that mitigate vacancy and deter demolition. Pilot projects could serve to explore interpretations of building regulations that facilitate temporary use, e.g., aiming to establish standard practices for defining temporary use. Allowing temporary deviations from city zoning these practices could be reassessed to foster greater flexibility for temporary uses. Additionally, publicly owned real estate in cities could be used as exemplars, although this would require political will and vision.

Economic. Pilot projects were highlighted as pivotal in promoting the adoption of temporary use for vacant spaces also from the economic perspective. These pilots offer opportunities to test and evaluate new operational frameworks for real estate management and associated value generation. Developing new business models, services, and roles to mediate temporary use is important. As an example, intermediary roles may be necessary to manage issues such as lease termination and to serve as intermediaries in mapping and connecting stakeholders, collaborators, and vacant spaces. In general, the real estate sector will need to transition towards a more adaptable operational model, departing from traditional long-term lease structures. Funding for culture, especially in the urban areas was suggested as an action to promote creative reuse. Finally, promoting temporary creative use would require defining value beyond the financial, i.e. incorporating social and environmental elements into real estate valuation.

Social. Temporary creative use brings social benefits within the local community. This needs to be considered and retained via actions, such as, experimentation, enhanced cultural access and the diversity of users. Incentives for the generation of social value would advance temporary use. However, nurturing collaboration and building mutual trust between the users and owners of the space is key. All stakeholders must learn to respect the temporality, i.e., the owners must be able to trust that the temporary users will vacate the space as agreed.

Technical. Mapping and evaluating vacant spaces, together with the need for an agency to mediate temporary use was considered the most important action. Further, an understanding of technical obstacles for temporary use needs to be developed. Collaboration between real estate owners and users were suggested to make vacant spaces safe and healthy without over-renovating them and thus limiting the environmental impact of temporary use. Space and equipment sharing solutions were suggested to be further developed.

Environmental. Highlighting the value of existing spaces and potential ways of reusing them would hinder their demolition. The environmental footprint of different solutions should weigh in decision-making. Holding properties vacant instead of using them should be considered from an environmental viewpoint, including energy use and resource efficiency. Temporary use and reuse of vacant spaces reduce the pressure for greenfield development, which should be better understood and communicated by cities and municipalities.

Table 1 presents a summary synthesis of the findings. The cross-analysis, focusing on the commonalities between the actions required to reach these two circular futures, is presented in the Discussion section.

Table 1 Summary of findings

Category	Relocation	Temporary creative use
Political	Hasten permitting	Hasten permitting
	Allow deviations from building code	Allow deviations from building code
	Relax city zoning practices	Relax city zoning practices
	Use public sector as trailblazers	Use public sector as trailblazers
	Favour reuse over new construction	Engage in pilot projects
Economic	Update valuation and appraisal methods	Update valuation and appraisal methods
	Create incentives	Create incentives
	Provide free access to practical guidance	Develop new business models (e.g. roles)
		Promote flexible, shorter-term lease contracts
		Fund creative reuse
Social	Increase attractiveness	Build trust and collaboration
	Enhance awareness	Nurture diversity, inclusiveness, democracy
	Educate, especially young professionals	Promote experimentation
Technical	Update education, promote R & D	Map and evaluate
	Use high quality materials	Overcome technical obstacles
	Implement high tech solutions	Promote health and safety
		Share space and equipment
Environmental	Adapt certification scheme	Prevent demolition
	Use low impact materials	Prevent greenfield development
		Highlight energy and resource efficiency

DISCUSSION

This paper set out to explore temporary creative use and relocation as circular strategies for asset and facility management. A key goal was to establish how these two strategies could become more common in the future. Several similarities came up in the workshops, although with differences as well.

Considering the political and legal perspective, the need for experimentality and flexibility in the implementation of regulations, zoning and policies is important. It could be a method for trying out new concepts and long-term plans and would make cities resilient to uncertainties and change. Both futures would benefit from a more relaxed interpretation of the building code, as well as deviations to city zoning. Through for example pilot projects, public sector has and could still act as trailblazers, setting good examples and sharing lessons learned from the projects. Governmental processes are discussed in the literature on temporary use, but less so for relocatable buildings. In the reviewed literature permits are investigated by Gamble (2024) in an American context. For example, in Sweden temporary building permits are possible and used for relocatable buildings. However, relocatable buildings are considered new construction when moved and need a new permit, which complicates the process and has been politically debated (Stenevi, 2021). These types of regulatory challenges must be overcome to achieve circularity.

The workshop results find that proficiency in circular principles and practices, and circularity as norm among policymakers, real estate owners, and facility managers would be needed. An established understanding of value retention from keeping buildings in use, and the importance of valuing environmental and social aspects alongside the financial was lifted as an important action in both workshops. Both temporary use and relocating buildings are well aligned with the principles of

sharing economy and access-over-ownership business models, although this is more established for relocatable building than for temporary use. Through leased building modules, especially the public sector users are free from the risk and cost of ownership, even though the lifecycle costs may be higher (Vihola & Edelman, 2016). The flexibility of the property portfolio is a much sought after quality in the midst of demographic and societal change. Different types of incentives, such as funding specifically for culture, or tax cuts were also discussed in both workshops.

As an example of potential new business models and services, the workshop participants suggest a mediator service for a successful and satisfactory implementation of temporary use projects and the use of relocatable buildings. Even possible variations in the role were pointed out, e.g. process management for development and collaboration, but also communication and network building, and connecting stakeholders and spaces. This is in line with the suggested use of independent and neutral mediators, which could ease the processes especially if the role of the mediator is clear and agreed upon (Hernberg, 2022). Further, participants suggest temporary users need to learn how to “let go” of spaces. This requires clear communication and agreements and an open dialogue and mutual understanding regarding value creation, regulations and policies, as well as instrumentalization (e.g. Madanipour, 2018; Matoga, 2019; Patti & Polyak, 2015; Zhang, 2018).

From the technological perspective, the most crucial action would be “future-fit” education. The literature shows that there has long been tradition and knowledge on relocating buildings (Gamble, 2024), and temporary use of vacant spaces has a long history as well. Circular thinking and environmental considerations bring more potential and new relevance for these practices. As previously addressed, this is not solely a technical matter that concerns only engineers but requires a holistic understanding that concerns facility and asset managers, along with architects and spatial planners – and the students in these areas.

The focus in research on relocatable buildings is much on the aspects of time- and cost-saving, materials and technical solutions, and relates to research on modular construction, which emphasizes the environmental benefits. In the workshop, it was suggested that the traditional building sector may even be eliminated in the future due to climate and environmental concerns. In other words, it would be enough to complement the existing building stock with relocatable buildings and make better use of the buildings, i.e. including temporary use. Considering this bold idea, it is even more important to enhance “siting”, landscape and architectural qualities in relocatable buildings (Edelman et al., 2016; Kyrö et al., 2019). Research on relocatable buildings only begins to raise the question of inclusive design processes and the involvement of stakeholders, which would increase the quality and “situatedness” of the relocatable buildings (Kyrö et al., 2019). Temporary creative use literature exhibits how inclusive processes carry the potential of addressing various and complex issues, a potential lesson learned for the practice of relocatable buildings also.

Young professionals hold the potential of being more experimental and bolder. Thus, construction methods of relocatable buildings, and modular thinking in temporary reuse (see e.g. Kawa et al., 2024), should be taught to and developed with students and practitioners. For example, the matter of landscape and siting quality would be relevant to explore with landscape architects and students, in interdisciplinary constellations with facility management. Enhanced knowledge and design could increase the quality, acceptance and interest in both relocatable buildings and temporary creative uses of vacant spaces. Lastly, the importance and increasing demand for mediators, e.g. facility managers, calls for honest acknowledgement and should be addressed in education (Hernberg, 2022).

CONCLUSIONS

When viewed through the logic of circularity principles for significantly reducing the environmental impact of the building sector and fostering circularity, both temporary use and relocatable buildings hold great potential. Still, both are underexplored as circular strategies in academic literature, and this study is among the first to combine the two. Our findings identify critical parameters and necessary

actions to reach the two preferable futures to sustain our planet's finite resources. Suggested actions range from adjusting lifecycle assessment and real estate valuation practices to creating mediator and consultancy roles to facilitate relocation and temporary use. Educating young professionals is seen necessary to allow for the transition. Wider implementation or relocatable buildings and temporary creative reuse would make cities and localities more resilient to uncertainty and change, while fostering a cultural shift toward circularity and creativity.

Thus, this study contributes to the emerging bodies of knowledge of both circular FM and future awareness in FM. We offer a novel outlook for policy makers, educators and facility management professionals as they navigate the transition towards circular practices. Despite recent advancements, employing futures studies methods in facility management research is still uncommon. Thus, the use of backcasting is a methodological novelty of this paper. The strength of the method lies in the ability to deviate from the path, finding novel ways toward a preferred future. This was achieved with participants in both workshops. Naturally, repeating the workshops with more participants from different backgrounds would bring further insights. Moreover, combining the two futures already in the data collection phase to one workshop considering both futures could validate the findings of this paper.

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AI DECLARATION

Bing AI was used in creating illustrations of the circular futures images (Figures 1a-b).

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Do AI Applications Compromise Ethics and Integrity in Facilities Management? Insights from the UK

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ABSTRACT

Background and Aim. AI applications are increasingly being utilised in facilities management (FM) for functions such as operational management, energy management and maintenance management. However, a larger part of the industry would rather use contemporary methods due to ethical and integrity concerns associated with AI applications. Hence, this study attempts to answer the question: Do AI applications compromise ethics and integrity in FM?

Methods. This is a qualitative study. As the research method, in-depth interviews are selected. FM professionals possessing relevant knowledge and experience in the UK have been chosen as experts. Thematic analysis has been adopted to analyse data. As this is ongoing research, preliminary findings obtained from the interview series are presented in this paper.

Results. Findings reveal that ethics and integrity can be compromised if the required security measures are not implemented within the systems and strategies in FM organisations. A framework has been developed to explain ethical AI adoption in FM, recommending alignment with GDPR and ISO standards.

Originality. Although several studies have been carried out exploring the use of AI applications in FM functions and have identified the issue of compromised ethics and integrity, only a few studies have focused on FM organisations and discussed FM-specific solutions. Hence, this study addresses a substantial research gap in FM.

Practical or Societal Implications. This study will motivate FM professionals to adopt AI applications with confidence and contribute to sustainable transformation in FM.

Type of Paper. Full Research

KEYWORDS: AI applications, digital transformation, ethics and integrity, facilities management

INTRODUCTION

Facilities Management (FM) encompasses the synchronised management of both hard FM and soft FM functions to ensure efficient facility performance and optimal working environments. Like other professional fields, Artificial Intelligence (AI) has transformed traditional FM operations and processes. The rapid advancement of AI has transformed FM through automation, predictive analytics, and optimised resource allocation (Marzouk and Zaher, 2020). AI has significantly contributed to reducing the time on facility data analysis, visualisation and data validation (Sampaio, Costa, & Flores-Colen, 2022; Rane, 2023). A few of the most prominent AI applications in FM include AI-based predictive maintenance, data-driven energy optimisation, real-time workplace optimisation, AI-enabled security and surveillance, chatbots and virtual assistants (Chen et al., 2024; Quinello & Nascimento, 2025).

Although digital transformation in FM is promising with AI applications, several challenges and limitations must be addressed. A primary barrier is the complexity of implementation and organisational change management. The substantial costs associated with IoT sensors, AI software,

and system integration often create financial barriers to adoption (Atkin and Bildsten, 2017). Furthermore, modifications to traditional workflows generate resistance among stakeholders. Data quality, privacy, bias, and governance are key aspects to be addressed prior to adopting AI-based transformation (Alhaj et al., 2022).

Importantly, the increasing use of AI in FM brings to light a range of ethical considerations that go beyond technical challenges. The quality and completeness of the datasets directly impact the accuracy of the decision-making. In addition, cybersecurity vulnerabilities in interconnected systems further compound risks by exposing sensitive operational and occupant data (Assaf et al., 2020). AI applications like facial recognition and occupant tracking raise significant ethical concerns regarding surveillance and personal privacy. Establishing robust governance protocols is essential to ensure responsible AI deployment while maintaining regulatory compliance and public trust. The rapid adoption of AI technologies has outpaced the development of robust ethical guidelines and governance frameworks, raising critical concerns about privacy violations, algorithmic bias, accountability gaps, and data integrity.

Recent UK-based commentary and cross-sectoral studies have also raised concerns around the ethical implications of AI in FM. Issues such as data ownership, surveillance, transparency, and reputational ethics are emerging as key themes in industry guidance and organisational responses (IWFM, 2017; RICS, 2024a; RICS, 2024b; Stahl et al., 2021). While these discussions provide important context, they also highlight the need for empirical, sector-specific research to understand how such concerns are interpreted and managed in FM practice. However, existing studies focus narrowly on the ethical and integrity-related challenges of AI adoption in FM, and only a few, such as Rane (2023), Almeida et al. (2022) and Stahl et al. (2021), explore how these issues are perceived and managed by professionals irrespective of the sector/industry. Despite several systematic reviews and theoretical studies, such as Soulami et al. (2024), empirical research that explores the ethical dilemmas surrounding AI adoption in FM remains scarce. Moreover, FM-specific research grounded in ethical governance frameworks remains limited, particularly in the UK context. This study addresses that gap by investigating how FM professionals in the UK understand, experience, and respond to the ethical implications of AI technologies.

Hence, this study attempts to answer the question: Do AI applications compromise ethics and integrity in FM? More specifically, it investigates:

- What ethical concerns are associated with AI adoption in FM functions?
- How are these concerns currently addressed within FM organisations?
- What strategies or frameworks are needed to support responsible and ethical AI integration in FM?

This is ongoing research. This paper presents the preliminary findings from the first phase of expert interviews within the UK FM sector. Hence, this study contributes to ongoing debates around AI ethics in applied settings and offers practical insights into responsible innovation in the built environment.

LITERATURE STUDY

AI Applications in Facilities Management

AI is increasingly transforming FM practices, moving organisations from reactive operations to proactive, data-driven decision-making. Recent studies highlight several domains where AI technologies are most impactful, including predictive maintenance, energy efficiency, workplace optimisation, space utilisation, service automation, and soft FM services such as facility operations and administration (Marzouk and Zaher, 2020; Quinello & Nascimento, 2025; Atkin and Bildsten, 2017).

Predictive maintenance has emerged as one of the most prominent AI applications, where real-time condition data from sensors is used to forecast asset performance and detect anomalies before failure occurs (Cheng et al., 2020; Zhang et al., 2022). This helps reduce unplanned downtime, lower

maintenance costs, and extend asset lifespan. AI-integrated Building Information Modelling (BIM) systems and IoT platforms further support emergency planning, building diagnostics, and fault prediction (Quinello & Nascimento, 2025). AI technologies also play a central role in building energy management. Smart control of HVAC, lighting, and power systems is increasingly enabled by machine learning algorithms that adjust system operations based on environmental conditions, occupancy, and historical usage patterns (Hosamo and Mazzetto, 2024). These insights are particularly relevant in hybrid work models and agile environments where space demand fluctuates (Vinnakota et al., 2022; Soulami et al., 2024). Soft FM services such as housekeeping, catering, and customer service also benefit from AI-supported scheduling, staff deployment, and quality monitoring (Atkin and Bildsten, 2017). These tools not only improve service delivery but also optimise resource allocation.

Natural Language Processing (NLP) tools are increasingly used to automate communications in FM (Assaf & Srouf, 2020; Albeshr et al., 2024). Generative AI tools such as ChatGPT have recently entered FM applications, assisting with documentation, reporting, and access to regulatory or technical information (Cheng et al., 2020; Rane, 2023). To address concerns about opaque decision-making, the concept of Explainable AI (XAI) has gained traction in FM. Transparent, voice-activated systems help users understand how AI decisions are made and build trust in automated service processes (Robert et al., 2020). This is especially important when AI influences decisions about occupant comfort, building safety, or service prioritisation. A summary of the major FM functions and their corresponding AI applications is presented in Table 1.

Table 1 Previous research on AI adoption in FM functions

FM Function	AI application	References
Predictive maintenance	<ul style="list-style-type: none"> - Big data analytics using ML - Deep Learning for fault detection - Digital Twins for diagnostics - Computer Vision (CV) for equipment condition monitoring 	Assaf & Srouf (2020); Bouabdallaoui et al. (2021); Cheng et al. (2020); Hosamo et al. (2022); Marzouk & Zaher (2020); Rane (2023); Soulami et al., (2024); Vinnakota et al. (2022)
Energy management	<ul style="list-style-type: none"> - ML for energy forecasting - Fault detection and diagnostics - Time Series Forecasting - Reinforcement Learning (RL) for energy optimisation - BIM-IoT integration for real-time performance adjustment 	Assaf & Srouf (2020); Chen et al. (2024); Hosamo et al. (2022); Hosamo & Mazzetto (2024); Rane (2023); Soulami et al. (2024); Vinnakota et al. (2022); Zhang et al. (2022)
Space Utilisation and Workplace Optimisation	<ul style="list-style-type: none"> - ML for occupancy prediction - CV for real-time occupancy analytics - Clustering for usage patterns - Fairness-aware AI for equitable planning 	Rane (2023); Soulami et al. (2024); Vinnakota et al. (2022); Zhang et al. (2022)
Security and Surveillance	<ul style="list-style-type: none"> - CV and Deep Learning for threat detection and facial recognition - NLP for command interpretation and incident reporting - Behavioural analytics using ML - Graph algorithms for access flow - Anomaly detection 	Robert et al. (2020); Stoilova (2021); Vinnakota et al. (2022)
Soft FM (Facility Operations and Administration)	<ul style="list-style-type: none"> - Robotics with CV and SLAM for cleaning and navigation - NLP-based chatbots and virtual assistants - Reinforcement Learning for Task Automation - Intelligent Process Automation (IPA) for administrative efficiency 	Albeshr et al. (2024); Alhaj et al. (2022); Atkin and Bildsten (2017); Bouabdallaoui et al. (2021); Chen et al. (2021); Chen and Tsai (2021); Hosamo and Mazzetto (2024); Marzouk and Zaher (2020); Pedral Sampaio et al. (2022); Rane (2023); Stoilova (2021); Vinnakota et al. (2022).

ETHICAL CONSIDERATIONS

The ethical concerns on AI adoption span multiple aspects, with privacy, fairness, accountability, and job displacement being central issues. Facial recognition technology raises significant privacy and security concerns, as it involves the collection and processing of sensitive personal data, which can be

vulnerable to misuse, breaches, or unauthorised access. Data protection concerns arise with large language models (LLMs) as employees may inadvertently input confidential data or documents when generating reports or analyses, increasing the risk of data leakage and unauthorised access (Rane, 2023). Moreover, biases inherent in AI decision-making may lead to unfair outcomes in areas like space optimisation. Biases in training data can result in unfair outcomes, marginalising certain groups or reinforcing existing inequalities (Jia et al., 2021). In employee management, this may manifest in biased recruitment or performance evaluation processes (Robert et al., 2020). The decisions of AI systems are questionable due to their black box nature (Robert et al., 2020).

AI's increasing role presents concerns related to the displacement of human labour and the reduction of job opportunities, with automation threatening specific job roles (Liang et al., 2024). Prioritising efficiency over social equity and environmental justice in AI deployment may exacerbate existing societal inequalities, disproportionately benefiting certain groups while disadvantaging others (Golkarfard et al., 2025). Furthermore, the absence of human experience in AI-driven systems, such as chatbots and virtual assistants, can lead to feelings of neglect among users, who may miss the emotional and empathetic elements of human interaction.

Industry bodies have also emphasised these risks. IWFM (2017) cautioned that AI adoption in FM may progress faster than ethical governance, highlighting the need for clearer rules on data ownership, accountability, and privacy. RICS (2024a) has underlined that FM professionals cannot hand over responsibility for ethical AI to vendors, while RICS (2024b) noted that many organisations remain underprepared for compliance and governance challenges. Similarly, Almeida et al. (2022) highlight the ethical tensions of facial recognition technologies, recommending stronger regulatory alignment, transparency, and accountability measures. Stahl et al. (2021) further argue that organisational ethics responses are often fragmented and reputationally driven rather than embedded in governance structure. Together, these studies reveal a persistent gap between ethical awareness and practice in FM.

MANAGING ETHICAL CONSIDERATIONS

The ethical considerations of AI systems, ranging from architecture to employee management, are complex, demanding proactive and thorough management. One of the primary concerns is privacy and security, particularly with technologies like facial recognition, which raise significant risks related to data protection and potential leaks (Almeida et al., 2022). Deploying facial recognition ethically requires transparent user consent (Bouabdallaoui et al., 2021). Furthermore, AI's dependence on large datasets increases the likelihood of inadvertent breaches, especially when employees input confidential documents or proprietary information into systems such as LLMs for analysis or reporting. Organisations must prioritise stringent data protection measures and establish clear protocols for safeguarding sensitive data (Assaf et al., 2020). Nolte et al. (2025) stated that memorisation of personal data by LLMs raises new obligations under GDPR, making accountability a key consideration.

Ensuring fairness in AI systems requires conscious efforts to incorporate diverse perspectives throughout the design and development stages. Moreover, the lack of transparency and explainability in many AI systems, often referred to as the "black box" problem, undermines trust in AI-driven decisions (Jia et al., 2021; Robert et al., 2020). This concern calls for AI solutions that are not only effective but also explainable, offering justifiable and evidence-based reasoning for their actions (Liang et al., 2024). AI systems in FM require careful implementation to enhance human capabilities rather than replacing workers (Mehdi et al., 2021). As AI continues to evolve, organisations must develop ethical governance frameworks that address these challenges, ensuring that AI integration is both responsible and beneficial to all stakeholders (e.g., Almeida et al., 2022). Almeida et al. (2022) specifically recommend Data Protection Impact Assessments (DPIAs), transparency requirements, and audit mechanisms to strengthen accountability.

To address these challenges, comprehensive regulatory frameworks are needed to guide the responsible development and deployment of AI technologies, ensuring they serve societal well-being

while safeguarding privacy, fairness, and job security (Golkarfard et al., 2025). However, Stahl et al. (2021) note that many organisational responses remain fragmented and reactive, creating uncertainty for professionals tasked with overseeing AI. Industry bodies also call for stronger governance. For instance, IWFM (2017) stressed the urgency of FM-specific ethical standards, and RICS (2024a) reaffirmed that accountability must remain with professionals, not systems. RICS (2024b) further highlighted the need for training and awareness across FM organisations to bridge the gap between ethics in principle and ethics in practice.

Finally, cultural reluctance remains a barrier to adoption. As by Zhang et al. (2022), organisational and regional culture significantly influence digital transformation in FM. Overcoming this requires not only robust governance but also stakeholder engagement to align AI systems with user expectations. Encouraging a culture of critical engagement with AI is essential to realising its potential responsibly. Despite these developments, limited empirical evidence exists on how FM professionals perceive and act on these challenges. This study, therefore, investigates how ethical considerations are understood and managed within FM organisations in the UK, contributing practice-informed insights into responsible AI adoption.

METHODS AND DATA

This study adopts a qualitative research methodology to explore the current landscape of AI adoption in the FM sector in the UK. The primary research method employed was an interview survey, with data collected through semi-structured interviews. Expert participants were identified through personal networking and by attending relevant public exhibitions and industry conferences within the UK. Selection criteria included demonstrable expertise in AI adoption within the FM field and current professional engagement in the UK industry. A total of three expert interviews were conducted during this initial phase of the study. In addition to the literature study, the presentations and panel discussions held at the Workplace and health and safety events from 8-10 April 2025, in Birmingham, have been useful in formulating the interview guideline with the knowledge attained on the current industry practice. The purpose of these interviews was twofold: first, to determine whether AI is actively being adopted in the FM sector, and second, to gain insights into the potential ethical considerations associated with such adoption.

During the interviews, participants were asked a series of questions designed to explore their perspectives on AI adoption in FM. The questions began with an introduction to the participants and their roles, followed by an assessment of their familiarity with AI applications in FM (e.g., *Briefly introduce yourself and your role, what is your level of familiarity with AI applications in FM?*). They were invited to share their perceptions of AI adoption, identify FM functions that benefit most from AI, and provide examples of practical applications (e.g., *How do you perceive AI adoption in FM?, what are the key FM functions that benefit the most from AI applications?, and can you share some examples of AI applications in FM?*). The discussion also examined the challenges associated with adopting AI, including ethical concerns, regulatory and professional barriers, and potential strategies or policies to overcome these obstacles (e.g., *What are the biggest challenges in adopting AI within the FM sector?, What ethical concerns arise from the use of AI in FM?, are there regulatory or professional barriers affecting AI adoption in FM?, and what strategies or policies could help mitigate these barriers?*). Finally, participants were asked about organisational approaches to training employees in AI adoption, ensuring a comprehensive understanding of current practices and challenges (e.g., *How does your organisation train employees in AI adoption?*).

Insights and views obtained from the participants through interviews were analysed using thematic analysis. As this is the initial stage of this research, the data was analysed manually, generating only three themes, which are a) the level of AI adoption in FM functions or tasks, b) ethical considerations and c) overcoming ethics-related challenges and opportunities towards smart FM. As the next step, a case study will be carried out to explore these aspects in the context of the UK.

RESULTS

Preliminary Interview Series

Table 2 below presents the details of the interviewees.

Table 2 Details of the interviewees

Interviewee code	Job position	Organisation type	Years of experience in the FM industry	Highest educational/professional qualifcn
I-01	Fire Risk Assessor	Non-profit housing association	10+ years	MSc in PM
I-02	Business Development Manager	Mobile computing software company	20+ years	Diploma in FM and Diploma in PM; FMP; APM
I-03	Founder of a Business Mgt Consultant firm	FM Consultant	11+ years	High School Diploma

Theme 1: The level of AI adoption in FM functions and tasks

With regards to the AI adoption in the FM field, interviewee I-01, who has been working as a Fire Risk Assessor in the UK, and has solid FM background, stated that some functions, such as preventive maintenance and energy management might benefit from using AI (i.e., machine learning) particularly for decision making. However, it cannot replace the requirement for human touch for certain tasks, such as customer services embedded in FM tasks, at least in the UK context. Interviewee I-01 further explained this view as below.

I am worried about losing the human touch and experience. Our organisation still uses a 24-hour customer service call line, and I think it's better, especially since our customers come from different backgrounds. Some aren't great with technology. For example, if we introduce a chatbot, it might be difficult for them to navigate... (I-01).

However, interviewee I-02, who is a Business Development Manager of an IT organisation, is optimistic about the current atmosphere of AI adoption and justified his stance as below.

We develop AI-driven smart solutions to enhance the experience of building occupants. We have several clients in the UK who use our products for facilities management functions...what we created was a kind of independent data layer for smart buildings, where whatever sensors you have in a building, we get all that data. We normalise the data and we show it to you in a meaningful way... (I-02). If you want to see your energy consumption, you want to see the air quality, you want to see the lighting, we put all this together to make sense to you...Based on data, we help you reduce waste (I-02).

Theme 2: Ethical considerations

Interviewee I-02, on the other hand, explained that there were no ethics-related issues or misalignment with GDPR, as they had successfully launched smart solutions for soft FM. I-02 further elaborated on this insight as follows:

Our work is aligned with GDPR. We protect users' confidentiality and privacy by only collecting IP addresses, which are deleted after 48 hours. This data helps with minor tasks like cleaning, which might seem small but are really important for workplace management... (I-02).

Let's say the toilet paper runs out in the washroom. Employees can inform management through their mobile phones. These types of data are useful for real-time solutions and help with decision-making in the long run (I-02).

However, I-02 agreed with the fact that there will be discomfort involved with collecting a certain type of data from employees at the organisational level. For example,

When a badge is used to record access and departure times, employees started questioning, but why do you need this?... Is someone going to look at my badge to know when I come in? What is HR going to do about it? (I-02)

Hence, they had to clarify all these queries, and before collecting data, alignment with the European Union Time Act was also needed. The interviewee I-02 further expressed on the current regulations on ethical consideration and highlighted that it is a “wild west” situation, and they have not been figured out completely.

Theme 3: Overcoming ethics-related challenges and opportunities towards smart FM

Both interviewees, I-02 and I-03, agreed that employees should be provided with proper training on boundaries regarding AI adoption, particularly on the use of LLMs such as ChatGPT. While there is a lack of standards or regulations on AI adoption in FM, it is up to organisations to implement bespoke systems that align with existing regulations such as GDPR and ISO 10016 FM.

Interviewee I-03 has been involved in developing ISO 10016 FM, which is a series of standards related to quality management systems. Although FM does not have a direct definition within this standard, it is still relevant due to its common use in the building management context.

Interviewee I-02 explained how their organisation implements and aligns with standardisation as *“When you think about smart buildings, there’s still a lot of bespoke setups. We say, let’s make it more standardised. So we make things interchangeable...We are a part of the Smart Building Council.”*

Regarding the future of FM practice in terms of AI adoption, both I-02 and I-03 have been positive. According to I-02, AI can be incorporated to enhance the productivity of decision-making. For instance, ‘let’s say errors are found in a fault detection system of a smart building and a total of 500,000 errors have been detected, AI can learn about alarms and detect fault notifications or filter serious issues.’

According to interviewees I-02 and I-03, the reluctance to adopt AI is a cultural phenomenon. Hence, together with policy development and implementation, understanding the requirements of stakeholders or end users is necessary to move towards smart FM.

DISCUSSION

AI adoption in FM has not been extensively researched, as it is still an emerging topic. Moreover, the existing empirical findings are largely based on research conducted as pilot studies, rather than studies undertaken within the industry using real datasets (e.g., Hosamo and Mazzetto, 2024). Hence, this study aimed to explore the level of AI adoption in the FM industry and the probable ethical considerations that occur as a result.

Findings of this study reveal that there are organisations in the UK actively using AI in several FM tasks, such as workplace management (i.e., housekeeping), energy management, and operations management (e.g., chatbots and ChatGPT). These findings align with prior research implications, particularly on the use of GenAI in almost every FM function (e.g., Vinnakota et al., 2022). Similarly, Chen and Tsai’s (2021) implications regarding the perks of using chatbots for producing progress reports on building inspection, housekeeping, preventive maintenance and disaster prevention through data analysis attained from chatbots are validated by the preliminary findings.

Furthermore, findings confirm that measures can be taken to address potential ethical considerations, including data protection and security in the real world. For instance, Interviewee I-03 explained that there were no ethics-related issues or misalignment with GDPR, as they protect users’ confidentiality and privacy by collecting anonymous data and only collecting IP addresses, which are deleted after 48 hours. Nevertheless, diverse perspectives must be incorporated in the design and training of AI systems to ensure fairness. For example, obtaining user consent, implementing an efficient cloud management system with high security, and conducting regular progress reviews when both machines and humans are involved in decision-making are suggested as appropriate measures to ensure ethical practice (Jia et al., 2021). It is also suggested that integrating a central AI system across FM functions can ensure consistency, transparency and better oversight (Jia et al., 2021).

The absence of standardised regulations governing AI adoption in FM, as highlighted by the interviewees, necessitates organisations to develop bespoke systems that comply with existing frameworks such as the GDPR and ISO standards (e.g., ISO 10016 FM). This approach resonates with the perspectives of Abdelalim et al. (2025), IWFM (2017), RICS (2024a) and (2024b), who advocate for the integration of AI within established quality management systems to ensure ethical compliance and operational efficiency.

Interviewee I-02's involvement with the Smart Building Council and the push towards standardisation in smart buildings reflects a growing trend in FM to adopt standardised solutions. This movement is corroborated by the work of Abdelalim et al. (2025), who emphasise the role of standardised frameworks in facilitating the seamless integration of AI and digital twin technologies into BIM systems, thereby enhancing predictive maintenance and operational efficiency.

Addressing ethical challenges in smart FM starts with equipping employees through targeted training. Clear guidance on the responsible use of AI tools, like ChatGPT, helps staff understand what's appropriate, particularly around data privacy and decision-making (Soulami et al., 2024). Robert et al. (2020), in their study, point out the unfairness caused by rapidly deploying AI systems to manage employees, utilising the organisational justice theory. It has been further explored that the complex issues that arise, other than protecting employees' privacy, such as determining autonomy in AI in decision-making and the means of holding AI accountable. These aspects should be taken into consideration when developing and modifying organisational structures, policies and norms.

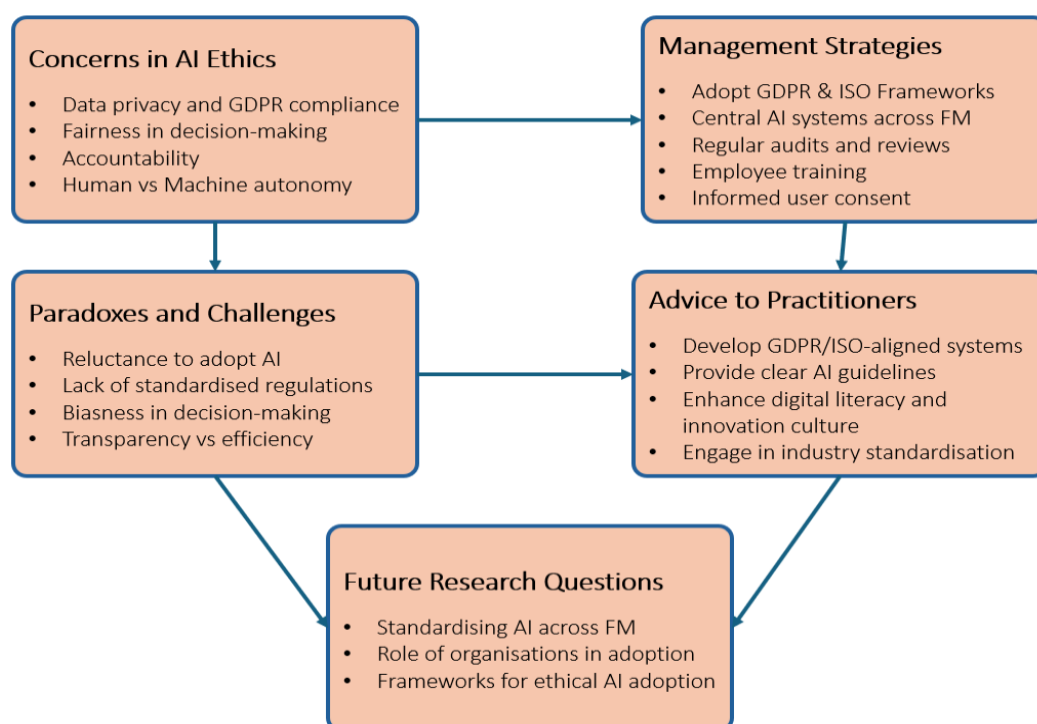


Figure 1 The framework for ethical AI adoption in FM. Source: Authors' own work.

However, the cultural reluctance to adopt AI, as noted by all the interviewees, presents a significant barrier. This sentiment is echoed in the literature, where organisational culture (even the culture in the region/country) is identified as a critical factor influencing the successful implementation of AI technologies. Addressing this requires not only policy development and stakeholder engagement but also a joint effort to foster a culture that embraces technological innovation. Together, these steps create a practical path for managing ethical risks while making the most of smart technologies

(Zhang et al., 2022). Accordingly, the framework presented in Figure 1 has been developed to explain ethical AI adoption in FM. The framework will be further refined and validated through future research.

CONCLUSIONS

This study set out to explore whether AI applications compromise ethics and integrity in Facilities Management, with a particular focus on current practices and perspectives within the UK context. Based on a literature review and preliminary interview findings, the study identified that AI is increasingly being integrated into several FM functions, including maintenance, energy management, and workplace optimisation. While these applications offer numerous benefits, they also present a range of ethical challenges.

The findings highlight issues such as data privacy, surveillance, algorithmic bias, and the lack of transparency in AI decision-making are central to ethical concerns. However, the study also revealed that these risks can be mitigated through appropriate governance measures. Aligning AI systems with frameworks such as GDPR and ISO standards, offering staff training on responsible AI use, and adopting transparent and inclusive design approaches emerged as key strategies for addressing ethical challenges.

As a limitation, the findings presented in this study are based on only three expert interviews, reflecting the challenges of data collection due to the limited availability of industry professionals and the sensitivity of the topic. Nevertheless, the insights gained offer a valuable foundation for future research by highlighting key ethical concerns and mitigation strategies in AI adoption within FM. The planned case study is anticipated to provide more comprehensive and contextualised insights into the practical implications of ethical AI integration, ultimately contributing to the development of context-specific guidelines that support responsible and ethical AI practices in Facilities Management.

AI DECLARATION

Language editing was carried out with AI-assisted tools to enhance readability and presentation, without generating or modifying the scholarly content.

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Smart Gardening Technologies for Promoting Sustainable FM - A Literature Review

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ABSTRACT

Background and Aim. Since 25% of global CO₂ emissions from real estate occur during the use phase of existing buildings, sustainable living and operation and maintenance (FM) concepts are required. While research focuses on environmental materials and economic FM, there is a lack of research on the social dimensions of sustainability – such as health, well-being, community engagement, or user satisfaction. This study explores the potential of smart gardening technologies (SGTs) to enhance the sustainability of existing residential buildings through FM, focusing particularly on social sustainability, while also considering the alignment with the 17 UN Sustainable Development Goals.

Methods and Data. In this study, a structured literature review is conducted. First, a quantitative analysis using a point-scoring system assessed the relevance of SGT-related literature across the 17 SDGs. Next, a qualitative analysis of the highest-rated literature identified is conducted to identify the impact on environmental, economic, and social dimensions of sustainability using specific criteria for existing residential buildings.

Results. The results show that SGT can support sustainability in residential housing by facilitating self-sufficiency (e.g. food production), reducing environmental impact, and increasing social interaction through shared green spaces. Key implementation factors include technological requirements, user acceptance, and integration into existing infrastructures.

Originality. The study highlights the role of SGT in supporting socially sustainable FM and contributes to bridging the gap between smart technologies and the human-centered aspects of sustainability.

Practical or Societal Implications. The results demonstrate how SGT can support socially responsible FM practices, increase resident engagement, and align facility strategies with SDGs related to health, food security, and community well-being.

Type of Paper: Full Research

KEYWORDS: residential buildings, SDGs, smart gardening technologies, social FM, sustainability

INTRODUCTION

The increasing importance on sustainability and life cycle issues in European and international regulations has placed significant pressure on the real estate industry, particularly in the area of facility management (FM) (Oktabec & Wills, 2024). These regulations not only mandate the construction sector to quantify the environmental impacts of building materials, such as embodied carbon, but also extend to the ongoing operation and maintenance (O&M) of buildings (Asdrubali et al., 2023). Facility managers are now required to implement practices that reduce energy consumption, minimize waste, and lower the overall carbon footprint of buildings through-out their entire life cycle. FM occurs in the operation phase of buildings, which is also the longest phase. The operational costs of a building, which account for 44% of its total life cycle costs (Bogenstätter, 2008; Litau, 2015a), represent the largest period throughout the lifecycle of buildings. Digitalization has become critical in the building sector, especially for enhancing operational efficiency and data-driven strategies (Barthel et al., 2024). The integration of IoT sensors (e.g. those monitoring humidity, temperature, and occupancy) along with Building Automation Systems (BAS) and Building Information Modeling (BIM),

is transforming FM by providing real-time data (Atta & Talamo, 2020). At the same time, economic and social pressures are rising. Climate change, health inequalities, and food insecurity are now viewed as systemic risks that requires holistic, cross-sectoral solutions (Veith et al., 2021).

Urban environments meet two challenges: rising compactness and limited space. In this context, technological innovations in sustainable urbanization, such as Smart Gardening Technologies (SGT), could present an interface between digitalization, sustainability, and self-sufficiency of building users within existing buildings. SGT offer an interdisciplinary solution that connects digital technologies, sustainability goals, and FM practices. As IoT-enabled systems that automate plant care and enable resource-efficient food production, they address all three pillars of sustainability. Environmentally, SGT reduce emissions and support biodiversity; economically, SGT lower operational costs and reduce resource consumption; socially, they promote user participation and community building. Within FM, SGTs can thus be seen as a practical interface that integrates technology, user engagement, and building processes to align with the broader objectives of sustainable development (Balyan et al., 2024). SGT offer the opportunity to conserve resources, improve biodiversity, support local food production, and foster community interaction, which aligns with the UN's Agenda 2030 and its multidimensional sustainability goals (Federal Ministry for Economic Cooperation and Development, 2023; Fuchs et al., 2022).

To date, research on sustainability for buildings primarily focuses on the environmental dimension, particularly on reducing CO₂ emissions (Straube, 2024), while research on the economic and the social dimension in real estate lack (Alber, 2014). Since the building sector is one of the most significant contributors to greenhouse gas emissions (Federal Environment Agency, 2024), integrated strategies that balance environmental, economic, and social goals are required. Yet FM remains underused in the context of solutions for holistic sustainability.

The objective of this paper is to investigate how SGT can improve the sustainability profile of existing residential buildings through FM. SGT, which combine digital innovation, local food production, and user participation, offer a multidimensional solution aligned with UN SDGs. Therefore, the central research question is: "What opportunities do SGT offer in existing buildings to address sustainability?" To answer the research question, a mixed-methods approach is applied. Literature is analysed and evaluated using a scoring system to assess environmental, economic, and social benefits.

The paper is organized as follows: Section 2 presents a short literature on sustainability in the building sector and SGT. Section 3 outlines the methodology and in section 4 the results are presented. The paper concludes with a summary and with an outlook on potential future research directions.

SUSTAINABILITY AND SMART GARDENING TECHNOLOGIES IN FM

The built environment plays a central role in global sustainability efforts. From the environmental perspective, the building sector, and especially existing buildings, are a key factor in reducing CO₂ emissions, which accounts for around 40% of global emissions (Fouad, 2023), whereof about 25 % of emissions are attributable to the use phase of buildings (Hasik et al., 2019). FM can influence the sustainability performance of buildings throughout their life cycle, particularly during the operational phase, which accounts for over 44% of total life cycle costs (Bogenstätter, 2008; Litau, 2015b). Sustainability in the building sector consists of three dimensions: environmental (enhancing energy efficiency and reducing emissions, especially in existing buildings), economic (reducing life cycle costs and maintaining asset value through sustainable operation), and social (promoting well-being by affordable housing and inclusive environments) (Lietzke-Prinz & Farny, 2024; Vornholz, 2021).

The UN's Agenda 2030 and its 17 SDGs offer a holistic framework for sustainable development, urging sectors like real estate and FM to address challenges related not only to climate change and resource efficiency but also to health, food security, and equity (Federal Ministry for Economic Cooperation and Development, 2023). Within this context, FM is not just a technical or economic function but a socio-technical system that shapes the everyday experiences of building users. Cities such as Frankfurt am Main (Germany) demonstrate how green urban infrastructure, including parks, green roofs, and

vertical greenery, can support public health, biodiversity, and social connections by the project “Green City” model (Magistrat der Stadt Frankfurt am Main, 2020). Urban gardening supports this concept by transforming underused urban spaces into productive green areas. Beyond food production, it improves thermal comfort, raises biodiversity, and strengthens community ties (Baier et al., 2024). These examples provide a foundation for considering how smaller-scale, user-driven interventions like SGT might complement broader urban strategies.

SGT extend traditional urban gardening practices by integrating digital tools and automated technologies such as IoT sensors, AI-driven apps, and controlled environment systems (e.g., hydroponics, vertical farming). These systems enable precise monitoring and automation of irrigation, lighting, and fertilization based on real-time environmental data (Chaudhary et al., 2024; Okoli & Kabaso, 2024). Mobile apps and AI-powered systems further support plant care, pest control, and gardening schedules (Dörr, 2020). Indoor and vertical farming solutions based on Controlled Environment Agriculture (CEA) offer resource-efficient methods for local food production, particularly in space-constrained urban environments (Ojo & Zahid, 2022; SharathKumar et al., 2020). Automated irrigation systems, often combined with soil moisture sensors, provide water supply to the specific needs of plants, supporting healthy growth while reducing water consumption and manual effort. Aquaponics adds another layer by combining fish farming and hydroponics in a symbiotic system that recycles nutrients and water (Sharma et al., 2018). Lighting represents another aspect of SGT, which can be divided into outdoor and indoor applications (Garg & Bansal, 2000; Peruffo et al., 2015). Lighting is critical in supporting plant growth in indoor environments when natural sunlight is insufficient (Marcos & Mai, 2020). In practical terms, SGT consist of core components such as soil moisture and light sensors, nutrient monitors, microcontrollers (e.g., Arduino or Raspberry Pi), and smartphone-based user interfaces. These systems are compatible with various spatial configurations, including balconies, rooftops, and building-integrated planters, making them adaptable to new and existing urban layouts. However, the effectiveness of SGT depends on factors such as sun exposure, access to power and water, and technical literacy of users. Retrofitting SGT into existing buildings or green spaces often requires coordination with FM teams to ensure infrastructure and maintenance protocols alignment. The growing market interest in such technologies is obvious; for example, 30% of German garden owners report interest in smart gardening solutions, especially for automated irrigation (Stihl AG, 2023).

SGT support all three dimensions of sustainability within the built environment. From an environmental perspective, they help reduce emissions, water usage, and energy demand by optimizing the application of resources through automated, sensor-driven systems. Additionally, by enabling localized food production and increasing urban vegetation, SGT can enhance biodiversity and contribute to more resilient ecosystems. Economically, these technologies offer potential cost savings by reducing the need for manual labour and minimizing water and energy inputs, thus supporting cost-effective facility management and preserving long-term asset value. Most importantly, from a social standpoint, SGT encourage active user participation, promote well-being, and foster community interaction. They create spaces for co-creation, informal learning, and social exchange, thereby strengthening social cohesion in residential settings (Baier et al., 2024; Dörr, 2020).

RESEARCH METHODOLOGY

To analyse the contribution of SGT to promoting sustainability in FM, a literature review based on a systematic assessment procedure for evaluation has been developed, following the approach of Oktabec and Wills (2024) and Wills et al. (2018) that have applied similar methods. The objective is to analyse the potential of smart gardening in the context of the United Nations' 17 Sustainable Development Goals (SDGs) and to provide a valuation of the technology impact across the three dimensions of sustainability. The focus is on technologies that directly affect sustainable use and design of buildings. Figure 1 shows the methodical approach that is carried out in five steps.

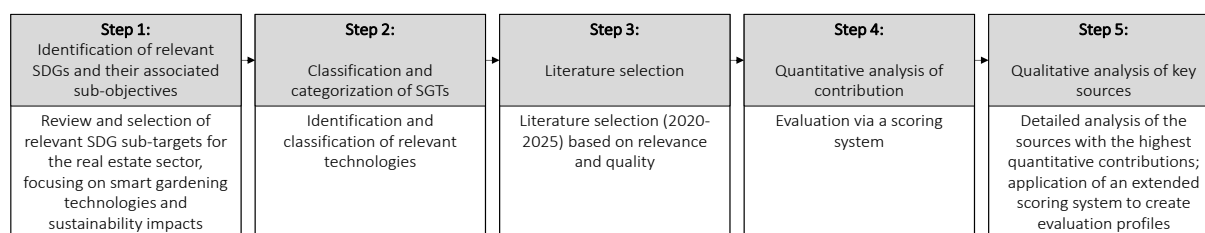


Figure 1 Methodical approach. Source: Authors' own work

Step 1: Identification of relevant SDGs

First, an identification of those SDGs and their associated target goals that are directly linked to SGT and its impact on existing buildings takes place. The selection of the relevant SDGs and target goals is based on a self-conducted research process that considers the sustainability potential of the technologies and belonging sources. The results are summarized in Table 1 and illustrate the identified SDGs with their respective target goals as well as the justification for the selection.

Table 1 Selection of relevant SDGs and target goals. Source: Authors' own work

DG	Explanation	Sources
2.4	SGT increases food production efficiency and supports sustainable farming in buildings.	25
3.9	Automated irrigation and reduced chemical use lower pollution and protect residents' health.	11
3.d	Sensors, robotics, and data analysis enable early detection of threats, minimizing pesticide use.	18
4.4	SGT in schools, farms, and community gardens promotes sustainable practices and builds skills.	19
4.7	SGT enhances understanding of ecology, resource use, and biodiversity.	16
6.3	SGT helps reduce water consumption and improves water quality through reuse systems.	14
6.4	Smart irrigation and sensors optimize water use, reducing waste in existing buildings.	15
7.2	SGT can run on renewable energy, powering lighting and irrigation systems.	11
7.3	Energy-efficient devices and smart controls cut energy use in gardens and buildings.	13
9.4	SGT promotes tech-driven sustainability in agriculture and urban green space design.	17
11.3	Using SGT in existing buildings positively affects user satisfaction by providing green spaces and enabling social interaction.	14
11.6	SGT can reduce water consumption, promote biodiversity, or improve urban climate.	13
11.7	Using SGT can help establish or improve green spaces and public areas in existing buildings, giving all residents access	5
12.2	SGT can support more efficient use of natural resources through resource-saving technologies and circular economy practices	18
12.5	SGT help reduce waste by enabling composting, recycling, and water reuse.	13
13.1	Reducing energy consumption by SGT, along with enhanced carbon storage in plants, can contribute to climate protection and support adaptation to climate change.	11

(Ampim et al., 2022; Blom et al., 2023; Chakraborty et al., 2022; Dal Moro et al., 2020; Dhanaraju et al., 2022; Fountas et al., 2020; Fussy & Papenbrock, 2022; Horst et al., 2017; Ibrahim et al., 2023; Kaiser et al., 2024; Kim et al., 2020; Kostadinova & Totev, 2023; Lidyawati et al., 2020; Lobillo-Eguibar et al., 2020; Malik, 2024; Mihailović et al., 2023; Navarro et al., 2020; Obirikorang et al., 2021; Pulighe & Lupia, 2020; Qazi et al., 2022; Quay et al., 2022; Rehman et al., 2022; Richter et al., 2023; Saiz-Rubio & Rovira-Más, 2020; Shukla et al., 2024; Song et al., 2022; Suárez-Cáceres et al., 2021; Velazquez-Gonzalez et al., 2022; Wong et al., 2020; Xu et al., 2024; Yanes et al., 2020)

Of the 169 SDG target goals, 16 were selected as only these can directly impact all three dimensions of sustainability through the use of SGT in existing buildings. The other target goals either have no influence or are indirectly involved in achieving the sustainability goals mentioned.

Step 2: Classification and categorization of SGT

To structure the identified potentials and contributions of SGT, the technologies extracted from the literature review (Step 1) are categorized as can be seen in Table 2. The categorization takes place in order to structure and interpret the results of the literature research in a logical way. The aim is to cluster technological developments thematically in order to better analyse and classify their effects on sustainability in FM.

Table 2 Classification of SGT. Source: Authors' own work based on (Wills et al., 2023, pp. 27–28), added with app-based applications and digital platforms (Arndt, 2024), and cultivation methods (Fussy & Papenbrock, 2022)

SGT	Example
Automation Technologies	automated irrigation systems (with soil moisture sensors and weather integration); robotics, e.g., robotic lawn mowers (autonomous mowing with obstacle detection and automatic return to the charging station); automated plant lighting (demand-based light adjustment for indoor and outdoor use) smart controls for irrigation and lighting, programmable and controllable via apps
Sensor technologies and IoT	sensors for monitoring soil moisture, humidity, light intensity, and temperature; connected devices that communicate via the Internet (e.g., moisture sensors)
Artificial Intelligence and ML	AI-powered analysis tools to improve plant care and to enhance and autonomously adapt systems such as irrigation or lighting over time
App-based applications and digital platforms	gardening apps for planning, care, and plant identification; online garden planners
Innovative cultivation methods	vertical farming; indoor farming; hydroponics; aquaponics

Step 3: Literature selection

Sources from the years 2020 to 2025 were considered. The “Consensus” database, the “Web of Science” database, and “Google Scholar” were selected as the sources for the literature search. The following keywords and research questions were used for the literature review: “smart agriculture”, “application of smart gardening in existing buildings”, “hydroponics in intelligent agriculture”, “indoor farming as a modern approach to poverty mitigation”, “aquaponics and smart gardening in residential buildings”, “micro-scale aquaponic systems”, “vertical farming in residential settings”, “urban smart vertical farming”, “urban smart gardening”, “smart gardening and fm”, and “building-based vegetable cultivation”. The keywords were also searched using different spellings, synonyms, and variations. Although the search delivered 242,840 results, only 32 sources were integrated into this study. A targeted selection was made based on the relevance and quality of the available sources. The results per keyword were documented and reviewed in detail. Bibliographic details such as author, title, source type, and year of publication were systematically recorded.

Step 4: Quantitative evaluation

SGT are evaluated based on their relevance to the previously identified SDGs and their specific target goals. The objective is to evaluate the scope to which each technology contributes to sustainability across the environmental, economic, and social dimensions. Therefore, a point-based scoring system is applied. The system makes it possible to measure how much each technology helps to achieve the different SDGs and their specific targets.

Each SGT is scored based on the number of sustainability dimensions it addresses and the degree of impact: 0 points indicate no contribution to sustainability, 1 point represents a minimal contribution, addressing only one sustainability dimension, 2 points reflect a significant contribution with measurable effects across two dimensions, 3 points denote a comprehensive and sustainable impact across all three dimensions. Each source or technology can receive a maximum of three points. The total score of all evaluated sources is aggregated and classified into four contribution levels, based on the percentage of the maximum possible score. Table 3 shows how the evaluated sources contribute to the SDGs.

Table 3 Contribution scale of quantitative assessment

Score	Level	Definition	Addressed dimensions	Aggregated contribution	Percentage range
0	no contribution	no identifiable contribution	-	0–23 points	< 25%
1	minimal contribution	minor effect, hardly noticeable	one	24–47 points	25–49%
2	moderate contribution	clear, measurable positive effects	two	48–71 points	50–74%
3	strong contribution	significant, comprehensive impact, promotes sustainability across the board	three	72–96 points	75–100%

Step 5: Qualitative evaluation

Nine criteria, grouped into the three dimensions of sustainability, were used for the qualitative evaluation of SGT. Each dimension includes three criteria guiding the review of sources and case studies.

A points-based system was developed to structure the evaluation. Each criterion scores one point (max. 9 per source). Based on total scores, sources are rated as having weak (0–3), moderate (4–6), or strong (7–9) sustainability impact.

RESULTS

This section presents the results of a two-step evaluation of the literature on SGT in FM. To ensure conceptual clarity, each dimension is analysed using three targeted research questions.

Quantitative Evaluation

The quantitative analysis showed that all 32 sources reviewed have sustainability impact. One had minimal relevance, addressing only one sustainability dimension, and seven showed moderate impact. For the qualitative analysis, only sources addressing all three sustainability dimensions and supporting key SDGs were included. Twenty-four sources met these criteria, each scoring the maximum three points, resulting in a total of 72 points, indicating a very strong contribution to sustainability. Table 4 shows the results.

Table 4 Sustainability Contribution Levels of Reviewed Sources

Contribution level	Percentage range	Point range	Score (sources × points)
no contribution	<25%	0–23 points	0
minimal contribution	25–49%	24–47 points	1
moderate contribution	50–74%	48–71 points	14
very strong contribution	75–100%	72–96 points	72

The data evaluation has shown that all SGT examined positively impact to sustainability in principle. The quantitative evaluation identified 24 out of 32 sources as particularly relevant. Twelve sources were identified that scored particularly highly in both the quantitative and qualitative assessments. Due to their considerable relevance and potential contribution to sustainable impacts, these sources are analysed in detail below. The following qualitative analysis evaluates each sustainability dimension based on three specific guiding questions per dimension.

Qualitative Evaluation

The *environmental* dimension is the foundation of sustainability, as a healthy environment is essential for economic growth and social well-being (Kropp, 2019; Moring & Inholte, 2022). In the context of FM, SGT can play a critical role in enhancing the environmental performance of existing buildings.

SGT improve resource efficiency by automating and optimizing water, light, and nutrient use. Aquaponics systems, for instance, integrate real-time IoT monitoring and energy-efficient LED lighting, enabling water and energy savings of up to 75% (Ibrahim et al., 2023). These closed-loop systems recycle water and nutrients between fish tanks and plant beds, reducing water consumption by up to 99% compared to conventional methods (Fussy & Papenbrock, 2022). For FM, this translates

into lower utility costs and more sustainable operations, especially in urban settings where energy and water conservation are critical for long-term asset efficiency.

SGT allow precise environmental control, minimizing the need for harmful agrochemicals. Automated irrigation and fertilization prevent overwatering and nutrient runoff, while hydroponic and aquaponic systems facilitate pesticide-free cultivation throughout the year (Velazquez-Gonzalez et al., 2022). Aquaponic systems reuse fish waste as fertilizer, closing nutrient loops and avoiding pollution. This protects water quality and supports species diversity by eliminating eutrophication effects commonly seen in traditional fish farming (Fussy & Papenbrock, 2022). Within FM, using these systems in green infrastructure or building-integrated agriculture supports environmental targets, enhances biodiversity, and contributes to corporate sustainability goals.

SGT address urban climate challenges: green roofs, vertical gardens, and indoor farming structures reduce surface temperatures, absorb CO₂, and increase humidity levels (Dal Moro et al., 2020). These solutions moderate urban heat island effects, which is especially important in dense urban areas. This highlights the potential of SGT to optimize the microclimate and reduce HVAC-related energy demands, which are key concerns for FM in both residential and commercial buildings. However, the effectiveness of SGT depends on proper system integration and ongoing monitoring. Challenges include regional climate differences and technical complexity, which require interdisciplinary expertise (Kim et al., 2020).

While discussing the *economic* dimension of SGT, the focus is on efficiency, value creation, and resilience, as they directly impact operating costs, property value, and long-term sustainability.

SGT such as vertical farming and hydroponic systems enable resource-efficient food production within buildings. Simulation-based studies show that VF systems can reuse energy and water while utilizing nutrient-rich greywater from the host building. Integration with aquifer thermal energy storage (ATES) enables the recovery and reuse of waste heat from LED lighting, potentially reducing HVAC-related energy demand by up to 51% (Blom et al., 2023). In FM, such synergies lower utility costs and support sustainable building operations. Additionally, private renters' compact, modular hydroponic units offer low-cost entry points into food self-production, with prices ranging from under €100 to €400 (Amazon, 2025).

By enabling food production in limited spaces, SGT increase the functionality of buildings and aesthetic value. Solutions like vertical farming façades combine green infrastructure with food cultivation, reducing CO₂ emissions and improving insulation (Shi et al., 2025). In FM, integrating SGT can serve as a differentiating feature in competitive housing or commercial real estate markets, particularly in cities with high sustainability standards. Furthermore, urban agriculture reduces supply chain dependencies by producing food locally, thus minimizing transport-related emissions and stabilizing food prices (Malik, 2024). A GIS-based study by Ma et al. (2025) identified rooftop farming potential in cities such as Singapore, Toronto, and Amsterdam, demonstrating that up to 112% of local demand could be met through optimized vertical agriculture.

SGT enhance urban food security by decoupling production from weather extremes and global supply chains. Indoor farming and digitally controlled irrigation protect crops from drought, floods, and seasonal variability (Fussy & Papenbrock, 2022, p.17). As a result, food production becomes predictable, year-round, and scalable, even in dense urban contexts. Economically, local production reduces exposure to global price volatility and import dependencies. Such systems enable new business models in food retail and urban logistics, offering FM a strategic role in local value chains and crisis preparedness. However, long-term empirical data is limited. Despite mitigation through LEDs and renewables, SGT still require high energy for lighting, pumps, and climate control. High upfront costs and technical complexity are major barriers. If mismanaged, nutrient-rich waste can harm the environment. Additionally, profitability varies by scale, and larger systems aren't always more cost-effective (Velazquez-Gonzalez et al., 2022). In FM, SGT offer various benefits for the social dimension

by enhancing air quality, enabling access to healthy food, fostering education, and strengthening community resilience and inclusion.

From social dimension, SGT such as vertical gardens, living walls, and indoor farms function as natural air filters, reducing CO₂ and acceptable dust levels while enriching oxygen content (Malik, 2024; Xu et al., 2024). These improvements positively affect the health and comfort of building users (Mihailović et al., 2023). Simultaneously, hydroponics and aquaponics allow on-site food production with minimal land use and no chemical inputs. Aquaponics reduces dependence on long-distance food transport, cutting emissions, and enhancing food security (Ibrahim et al., 2023, p. 22). For FM, integrating these systems supports localized, resilient supply chains and sustainable building operations.

SGT make sustainable agriculture visible and tangible. Systems such as aquaponics demonstrate closed-loop nutrient cycles, from water treatment to harvest, while digital platforms provide real-time insights into environmental and operational performance. A study by Lobillo-Eguíbar et al. (2020) provided economic metrics, revealing investment costs (€350), and the potential for cost recovery under real-life conditions. These data-driven systems support FM by offering a foundation for educational programming, performance tracking, and decision-making. Additionally, they serve as platforms for urban agriculture research, including climate adaptation, energy savings, and economic modelling.

SGT facilitate inclusive participation by offering barrier-free gardening solutions. Automation and sensor-based systems make it easier for elderly and mobility-impaired individuals to contribute to shared green spaces. Initiatives like home food gardening allow residents to cultivate edible or medicinal plants in private spaces (e.g., balconies, rooftops), fostering neighbourhood connections through food exchange and co-creation (Xu et al., 2024).

In summary, the analysis shows that SGT are integrated socio-technical systems. Environmental benefits, such as the reduction of emissions and the support of biodiversity, fit with their economic potential FM. Moreover, social benefits, e.g., community engagement, education, and inclusion, create feedback loops that enhance long-term sustainability. Therefore, the relevance of SGT in FM and placing them as tools that respond holistically to multiple SDGs, particularly SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), and SDG 13 (Climate Action), can be considered.

CONCLUSIONS

This study examined the potential of SGT to address the sustainable dimensions of existing urban buildings. First, the contribution of SGT to the SDGs was assessed through a quantitative analysis of relevant literature using a point-scoring system, followed by a qualitative evaluation of the highest-rated studies to explore the environmental, economic, and social impacts based on specific criteria for existing residential buildings. The findings demonstrate that SGT, such as aquaponics, hydroponics, and vertical farming, can significantly reduce resource consumption, promote biodiversity, and enable closed-loop nutrient cycles. Economically, these technologies offer opportunities to lower operating costs and increase property value, though more long-term empirical research is needed to validate their profitability. Socially, community-based gardening projects can improve user satisfaction and social unity. However, the complexity of the systems might raise challenges. Successful implementation of SGT depends on a holistic, collaborative, and inclusive approach regarding the specific needs of local conditions. Nevertheless, this study has limitations: the study only reviewed a few articles, and the subjective weighting of SDGs and sub-goals may influence the developed point-scoring system. The evaluation method limits comparability with other studies, and technologies like aeroponics were not included. Future research should broaden the data pool, test alternative evaluation methods, and incorporate empirical studies to validate and expand the findings.

DATA AVAILABILITY STATEMENT

Please visit https://www.thm.de/wi/images/Literature_collection_full_version.pdf for full literature review table.

AI DECLARATION

Artificial intelligence (AI) tools were used solely for language editing and improving clarity. No AI tools were used to generate content, analyse data, or influence the study's results. All intellectual contributions, ideas, and interpretations presented in this paper are the authors' own work.

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Public Sector Asset Management in the Context of a Just Transition – Guidance from Professional Bodies in The United Kingdom

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ABSTRACT

Background and Aim. The Intergovernmental Panel on Climate Change (IPCC) has stated a just transition will “ensure no people, workers, places, sectors, countries or regions are left behind” in decarbonisation. The paper aims to understand if professional bodies issue practitioner guidance that recognises a link between the climate crisis, decarbonising the built environment and a just transition.

Methods and Data. The paper presents qualitative and quantitative insights from publicly available guidance for public sector professionals working in the United Kingdom (UK) built environment. Qualitative Content Analysis (QCA) was applied to literature sampled from 21 professional bodies.

Results. A sample of 45 publicly available guidance documents indicate the phrase ‘just transition’ appears only 27 times compared to words like ‘climate’ and ‘carbon’ which appear 5,499 and 1,842 times respectively. The results suggest an opportunity exists for practitioner guidance to communicate the concept of a just transition more clearly and visibly in relation to the climate crisis and decarbonisation.

Originality. The paper evidences the opportunity for professional bodies in the UK to establish and communicate professional practice guidance that takes account of a just transition, it will however be of interest to professionals and academics outside of the UK.

Practical Implications. The paper supports facilities (asset) management professionals, and their professional bodies, to reflect on a just transition in the context of the professions and professional practice.

Type of Paper. Full Research.

KEYWORDS. asset management, investment, professional practice, public interest, just transition

INTRODUCTION

Facilities management professionals (and property asset management professionals) working in the United Kingdom (UK) public sector have the potential to perform a unique role in supporting a just transition. The paper aims to better understand whether professional bodies issue practitioner guidance that recognises a link between the climate crisis, decarbonising the built environment and a just transition. Evidence is presented to suggest professionals and the professional bodies associated with managing the public estate could do more to promote sustainable practices, thereby delivering “...development that meets the needs of the present without compromising the ability of future generations to meet their needs” (Our Common Future, 1987).

Buildings are responsible for 39% of global carbon emissions, decarbonising the built environment is one of the most cost-effective ways to mitigate the worst effects of the climate crisis. (World Green Buildings Council, 2019). The UK Public Sector has developed a custom and practice of underinvesting in existing asset inventories (O'Hara, Jones, & Wanigarathna, 2023) resulting in significant investment backlogs, potentially creating conditions for negative unintended consequences (O'Hara, Jones, & Wanigarathna, 2024). Examples of the negative consequences of underinvestment include

premature asset replacement, negative carbon impacts and weakening of the wider economy, plus otherwise avoidable costs that will need to be met by future generations (Shahin and Walther, 1990., HM Treasury, 2020., Percoco, 2012., World Green Buildings Council, 2019). The World Conference in Rio de Janeiro (1992) recognised existing production and consumption systems will lead to a global catastrophe. The current approach to producing and consuming built assets in the UK, and the associated underinvestment in the maintenance of the public estate is inconsistent with sustainability theory (Our Common Future, 1987). Numerous scholars have emphasised the importance of taking immediate action on climate change to avoid passing on the costs of the energy transition to future generations. Postponing these costs will only lead to higher expenses, as more rapid action will be required in the future to achieve global goals (Grub & Wentworth, 2023).

Professions can be seen as means of making expertise available for public good, and professional ethics as offering a safeguard against external pressures such as those of bureaucracy and the market (Lester, 2015). Practitioners and their professional bodies have a duty to appraise what they do in the context of public good, a duty which 'licenses them to be more than passive servants of the state, of capital of the firm, of the client, or even of the immediate public' (Freidson, 2001, p. 216-217). It would therefore seem that the professions and professionals associated with designing, constructing, managing and maintaining built property assets might be uniquely placed to support and promote a just transition.

Using Qualitative Content Analysis (QCA) the paper aims to better understand whether professional bodies issue practitioner guidance that recognises a link between the climate crisis, decarbonising the built environment and a just transition. Literature was sampled from a range of UK professional bodies based on a predefined criterion and analysed based on three research questions:

- Research Question 1 (RQ1). What frameworks and practitioner guidance exists to support UK public sector asset management?
- Research Question 2 (RQ2). How does practitioner guidance address current investment backlogs and longer-term asset liabilities (e.g. decarbonisation costs etc) which could impact future generations?
- Research Question 3 (RQ3). Does practitioner guidance recognise any link between the climate crisis, decarbonising the built environment and a just transition?

While this study is positioned among many others devoted to the topic of the built environment, facilities management and property asset management, it adds to the body of existing work by considering the relationship between the professions and professionals associated with managing property assets and a just transition. The originality of the study stems from the fact it considers the linkage between the climate crisis, decarbonisation and a just transition through the guidance issued to professionals, an aspect which has received limited consideration to date. As such, the paper contributes to creating a broad composite analysis of existing professional practice guidance (grey literature), indicating areas of underdeveloped research and opportunities for future research.

LITERATURE STUDY

The Role of the Professions and Corporate Social Responsibility (CSR)

In 2015 the Chartered Institute of Building (CIOB) published a report entitled 'Understanding the value of professionals and professional bodies'. This report explains that professional bodies are concerned with public benefit, putting forward the argument that professional bodies, especially those associated with the built environment, are today more important to the welfare of the nation than they have been for a very long time - underpinning issues such as social mobility, ethics and good governance. The report is however relatively silent on the issue of climate change and a just transition.

There is an extensive body of literature relating to the professions and the role of professionals, including for example, Elliott 1972 and Evetts 2003. Elliott (1972) establishes four basic characteristics

in the way that the concept of the professions is applied: 1) a distinct body of knowledge, 2) barriers to entry, 3) serving the public, and 4) mutual recognition. Evetts (2003) notes similar features including the power to define the nature of problems as well as control over the access to solutions and working for the public good (e.g. the long-term public interest). Hughes and Hughes (2012) describe a key feature of a professional institution as the commitment to serve the public interest. Equally these authors highlight that notions such as the public good or society's interests are not always clear and often inextricably linked to ideology, therefore, it may be asking too much to expect a professional group to determine public good and to respond accordingly.

Similarly, corporate social responsibility (CSR), which has its origins in 19th century philanthropists, frames a growing requirement for organisations to deal with reputation management and public interest along with issues such as the climate, biodiversity and a just transition. The Royal Institution of Chartered Surveyors (RICS, 2016) suggests that CSR involves going beyond the minimum legal and professional requirements and following certain principles to ensure any potentially negative impacts of professional work are minimised. As Green et al (2008) point out, the CSR agenda is a response to the kind of unregulated enterprise culture that has often been seen as destructive in society. Hughes and Hughes (2012) suggest sustainability is increasingly seen as the driving force of the CSR agenda. In other words, in the absence of professional codes of conduct, socially aware businesses can derive competitive benefit by regulating and presenting themselves in a socially responsible way. Birollo, Esper, & Rouleau (2021) argue that environmental issues such as climate change and corporate scandals have positioned businesses at the centre of public scrutiny. Accordingly, corporate social responsibility (CSR) encapsulates the idea that businesses (and their staff) should go beyond purely abiding by the law.

Hughes and Hughes (2012) pose the question, are professional bodies still relevant today in the light of the growing sustainability agenda. They conclude the rise of professional institutions in emerging economies points to a particular kind of sociopolitical environment in which some of the key concepts underpinning professionalism have a strong legitimacy. These aspects revolve around ethical codes and self-regulation which may fill a vacuum in some jurisdictions. They suggest this is likely to continue; not least because the sustainability agenda will require high levels of technical expertise and professional judgement in cross-disciplinary groups of diverse stakeholders. Shepard (2015) identifies general principles for opening people's eyes to climate change, demonstrating the potentially powerful integrative, educational & visionary role professionals can play in engaging society on climate change. So, there is an argument that the professions, through their role in serving public interest, combined with CSR and the burgeoning sustainability agenda, could (or perhaps should) play a role in supporting and delivering a just transition.

The built environment and climate change

New estimates from the 'Economic significance of maintenance report', compiled by the BCIS in 2024, shows the value of the building maintenance market in 2023 was circa. £96.46bn, more than £1.85bn a week. This would value the UK Facilities Management (FM) market at around 3.5% of UK GDP. The management, maintenance and repair of buildings is clearly a significant contributor to the wealth and wellbeing of the UK. Simultaneously we know that buildings account for 39% of global carbon emissions, and as such, decarbonising the built environment is one of the most cost-effective ways to mitigate climate breakdown, with embodied carbon contributing around 11% of all global emissions (World Green Buildings Council, 2019). The House of Commons Environmental Audit Committee (2022) report entitled 'Building to net zero: costing carbon in construction' explains that the UK built environment is responsible for approximately 25% of total UK greenhouse gas emissions. It is also commonly acknowledged that 80% of buildings that will exist in 2050 have already been built (UK Green Building Council: Climate Change Mitigation). It is clear therefore that the built environment has an important role to play in terms of both the economy and the climate crisis.

Henderson (2015) suggests that leaders will be required to find a way of managing the tension between 'exploitation' and 'exploration' i.e. the discontinuities between the status quo and the new

alternative (low carbon) future. Bresnahan (2012), Christensen (1997) and Tushman & Romanelli (1985) explain that one of the reasons we fail to address such discontinuities is that investments in the future are rarely immediately profitable, and convention requires immediate short-term returns. Transformative investment, by way of contrast, requires a sophisticated understanding of the risks entailed in doing nothing. Malekpour et al (2017) explore why strategic planning for built assets represents a major challenge and why it frequently returns unsustainable outcomes. Importantly this work acknowledges that investment in built assets continues to have adverse social and environmental impacts resulting in a divergence between vision and practice.

Ultimately professionals associated with constructing and managing property assets have a unique opportunity to advance sustainable development in the built environment, delivering “...development that meets the needs of the present without compromising the ability of future generations to meet their needs” (Our Common Future, 1987), which seems broadly consistent with the concept of achieving a just transition (Borge & Hopland, 2012., Grub & Wentworth, 2023., and Winkler, H., 2020).

Just Transition

The term “transition” is broadly used in many scientific disciplines to refer to a non-linear shift from one dynamic equilibrium to another (Loorbach et al. 2017). The shift away from current unsustainable practices will render some production and consumption patterns obsolete, threatening jobs and investments. This realisation underpins the concept of a just transition, which means “the cost of the necessary changes that deliver all of us a more stable climate must be spread evenly and not fall heavily and disproportionately on workers, particularly those in carbon-exposed industries” (Huggard 2019). Globally, we need a new equilibrium that secures solid social foundations within the limits of the planet (Rockström et al. 2009; Raworth 2017). Numerous scholars have emphasised the importance of taking immediate action on climate change to avoid passing on the costs of the energy transition to future generations. Postponing maintenance spend will only lead to higher costs in the future (Grub & Wentworth, 2023). This frames one practical opportunity for facilities (asset) management professionals to actively support a just transition - good stewardship of existing built asset stocks and proactive investment in maintenance can support a just (intergenerational) transition – ensuring future generations are not disproportionately burdened with deferred costs.

RESEARCH METHODS

The literature review was conducted in 2 discrete phases. Phase 1 comprised of a broad unstructured literature review focused on three contextual aspects (1) the role of the professions, (2) decarbonisation of the built environment, and (3) the just transition. A hybrid research methodology was adopted based upon unstructured digital library searches combined with backwards and forward snowballing (Mourão, E., et al 2020). The Litmaps literature review tool was used to support the process, enabling the search and visualisation of academic papers and their connections through citations and references.

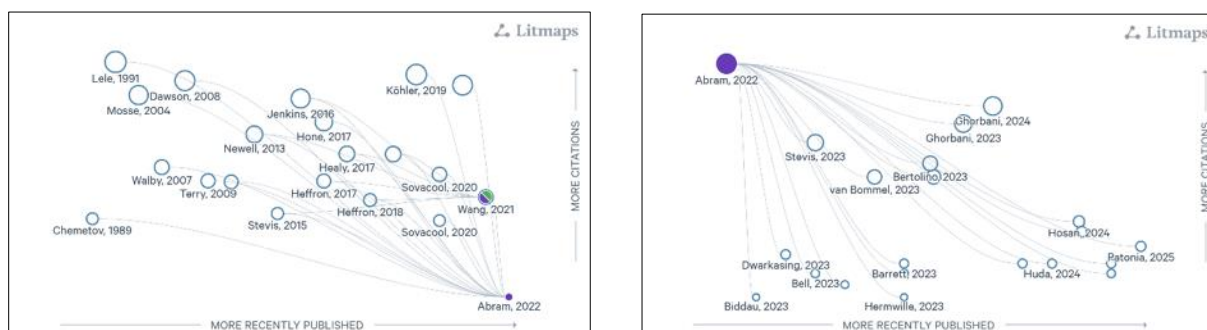


Figure 1 Illustration of Litmaps backwards and forward snowballing. Source: Litmaps.

Phase 2 involved a targeted review of grey literature. A structured methodology was adopted to access this naturally occurring data (NOD). A purposive criterion-based sampling strategy was adopted. The websites for the 21 professional bodies listed in Appendix A were interrogated using two approaches:

- Approach 1. a manual review of webpages and associated documents.
- Approach 2. an automated review using the search function on each website.

To validate the document selection an email was sent to each professional body asking that they validate the document selection based on a predefined criterion. A response rate of 43% was achieved. Qualitative Content Analysis (QCA) was then applied to analyse the frequency distribution of words and phrases. Content analysis is a popular and rapidly expanding technique for quantitative research (Neuendorf, 2017). Word (phrase) frequencies detail how often specified words (or phrases) are found in the text documents. The omission or infrequent use of expected words (or phrases) may also be meaningful for some research purposes (Drisko & Maschi, 2015). A problem-driven analysis approach was adopted, based on a desire to know something currently inaccessible and the belief that analysis of potentially available texts and other data can provide answers (Krippendorff, 2019). Each body of text was systematically read, and a coding framework applied to capture and categorise content within the texts.

RESULTS

The summative Qualitative Content Analysis (QCA) process yielded several qualitative and quantitative insights to help capture and categorise manifest and latent content within the texts, allowing meanings to be inferred from them. When the document selection criterion was applied only eight of the 21 eligible professional bodies had freely available relevant professional guidance (Figure 2).

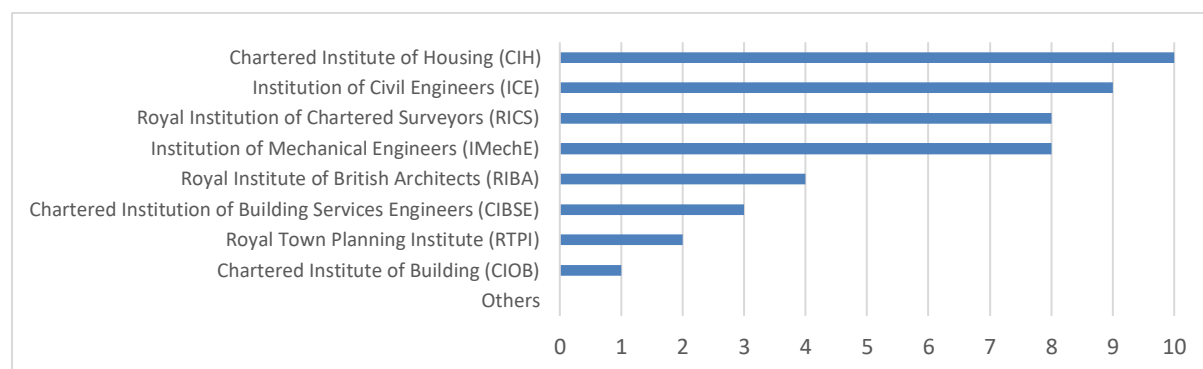


Figure 2 Number of documents sourced from each professional body based on a predefined criterion. Source: Authors' own work.

An analysis of the date of publication (Figure 3) demonstrated that there was a pronounced increase in the number of documents meeting the document selection criterion in the period between 2021 and 2023, with 24 out of 45 documents selected published during this period. It is also worth noting that the peak in 2022 was not sustained and the production of new relevant guidance appears to be in decline thereafter.

In the documentation examined the phrases 'carbon', 'climate' and 'asset' all appeared very frequently with phrases such as 'governance', 'just transition' and 'backlogs' hardly appearing at all within the text examined. In total six out of 45 documents include the phrase 'just transition' with the phrase only appearing a total of 27 times. By way of contrast 32 out of 45 documents include the phrase 'Climate' which appeared a total of 1,842 times.

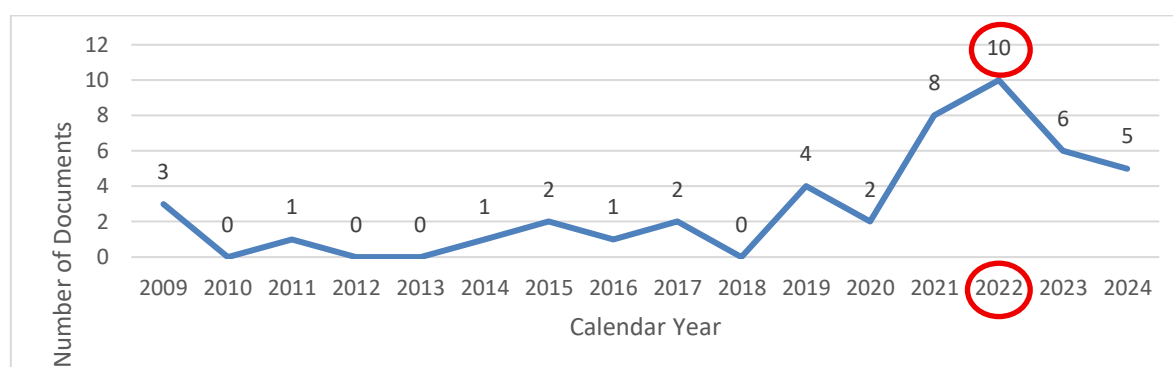


Figure 3 Year in which each professional guidance document was published. Source: Author's own work.

To understand if a relationship between climate, decarbonisation and just transition is recognised in the documentation examined, an analysis of word combinations was undertaken. This suggests, as shown in Table 1 below, that the word combination of climate and decarbonisation occurs in 23 of the 45 documents examined. The presence of climate, decarbonisation and just transition only occurs simultaneously in three out of 45 documents.

Table 1 Analysis of word combinations

Word combinations	Combination	Total word count	Number of documents with the combination
Climate	Only one phrase is counted in the document	1,842	27 Documents
Climate + Decarbonisation	Both phrases are counted in the same document	2,125	23 Documents
Climate + Decarbonisation + Just Transition	All three words are counted in the same document	201	3 Documents

Overall, only 45 documents, based on an initial screening, appeared to fit the set criterion. It was apparent that numerous other documents exist, but they were in most cases only accessible by full (paid up) members of the professional body. The larger and more high-profile professional bodies had freely available guidance that could be accessed by non-members. On closer examination approximately 50% of the material selected did not qualify as professional guidance, with only 43% of the 21 professional bodies able to validate the document criterion had been met and that the document selection was appropriate based on the set criterion.

RESULTS

Within the 45 documents examined it has been possible to identify practitioner guidance and frameworks to support UK public sector asset management. For example, checklists by the Institute of Civil Engineers (ICE), some documents referenced BS ISO 55000 standard series, PAS 2080 and outputs from the European standards body CEN's Technical Committee CEN/TC 350, which develops standards related to sustainable construction. Other notable frameworks contained within the sampled literature included the ICE Carbon Reduction Curve, the Institution of Mechanical Engineers (IMechE) Energy Hierarchy, and the IMechE Mitigation, Adaptation and Geo-engineering (MAG) integrated policy. How these various contributions work together in a coherent and unified manner is less clear. Overall, it can be concluded in response to Research Question 1 (RQ1) that a diverse range of frameworks and practitioner guidance exists to support UK public sector asset management.

With regards to Research Question 2 (RQ2) the data gathered indicated there is no recognition of the issue of investment (maintenance) backlogs or existing liabilities within the documentation examined and the potential for long-term liabilities to negatively impact future generations. That said, one of the ICE documents examined makes the point that the UK Government has made clear that the first step to delivering a green industrial revolution is "ensuring that the information exists to enable every

financial decision to factor in climate change and the environment” (HM Government (2021) Greening finance: a roadmap to sustainable investing). This would suggest that data such as whole life cost of carbon and existing backlog investment requirements will be of increasing importance moving forward. Interestingly the Chartered Institute of Building (CIOB) indicated in one of their documents, that in Ireland, they are calling for demolition to be charged at the standard rate of 23% VAT, while repair and renovation activities remain at the reduced rate of 13.5%, creating an environment where the embodied-carbon-hungry activities of demolition and replacement no longer enjoy financial parity with the sustainable repair and restoration practices. Bringing such practices in line with the principles outlined in the Circular Economy and Miscellaneous Provisions Act 2022 and the Climate Action and Low Carbon Development (Amendment) Act 2021. This signals an emerging and firmer stance on issues like decarbonisation and a move towards challenging the status quo in the interest of public good and intergenerational equality.

Finally in terms of Research Question 3 (RQ3) except for the Chartered Institute of Housing (CIH) and the ICE, the practitioner guidance examined did not recognise any link between the climate crisis, decarbonising the built environment and a just transition. The CIH emphasises the need for a fabric first approach (making homes as energy efficient as possible before installing renewable heating systems) and a just transition, ensuring that the sector can continue to reduce fuel poverty and keep rents affordable. They also highlight that the current inadequate financial support from Government risks pushing people on low incomes into poverty which is against the principles of a Just Transition. The ICE makes the point that paying due attention to ensuring a just transition to net zero has the potential to rejuvenate regional economies, enable local communities to play a key role in shaping their low-carbon futures and provide skills, training and employment opportunities for both existing and future workers - suggesting supporting a just transition can bring both social and economic benefits.

DISCUSSION

The analysis undertaken provides evidence that a series of standards and frameworks exist to support public sector facilities (asset) managers. However, they are generally silent in relation to the issue of backlogs and the just transition. The content examined is consistent with Elliott’s view (Elliott, 1972) that the professions are characterised by a distinct body of knowledge. There is however limited evidence of mutual recognition between the bodies in the literature reviewed, one of the four characteristics Elliott identifies as central to professional bodies. Serving the public is evident in the literature reviewed, a third key characteristic of the professions according to Elliott, however the limited acknowledgement of a just transition suggests a potential gap in professional guidance. This raises a question, regarding the role of the professions in issues such as the energy transition, and in turn begs the question, should professional guidance do more to promote a just transition, so that public good is promoted across all of society.

The relationship between maintenance liabilities (backlogs), longer-term liabilities arising from decarbonisation and adaptation costs is not explicitly made in the literature reviewed. It is however recognised in the literature reviewed (CIBSE, 2015) that that provision of suitable and appropriate maintenance is a legal requirement. It is also recognised that in a capital constrained environment, there can be a bias towards selecting solutions with the lowest initial cost rather than considering the whole-life total expenditure which includes capital, operational and decommissioning costs. The requirement to shift away from unsustainable practices and how this will render some production and consumption patterns obsolete, impacting jobs and investments (Huggard 2019) is however largely ignored. Again, an opportunity appears to exist for the professions to do more to promote the type of equilibrium described by Rockström et al. 2009 and Raworth 2017, which involves operating within planetary limits while strengthening social foundations.

The relationship between climate and decarbonisation is recognised in the literature reviewed, a point less well made is the broader link and relationship to a just transition and the role of professionals to appraise what they do regarding public good (Freidson, 2004). The role of professionals and

professional bodies in providing leadership means addressing and managing the discontinuities between the status quo and the new low carbon future (Henderson, 2015). As highlighted by Malekpour et al (2017), decision-making for investment in built assets always entails trade-offs relating to conflicting objectives, multiple uncertainties, and irreducible uncertainties. Embracing and promoting the CSR agenda therefore appears to be an important counterbalance to the enterprise culture that can be seen as destructive (Green et al., 2008). Given that a key feature of the professions is the commitment to serve the public interest (Hughes and Hughes, 2012), and that the professions have a powerful educational and visionary role to play in engaging society on climate change (Sheppard, 2015). There does appear to be an argument that the professions, through their role in serving public interest, combined with CSR and the burgeoning sustainability agenda, could (or perhaps should) play a greater role in supporting and delivering a just transition. But only if they can rise to the challenge of evolving a refreshed conception of professionalism, as this study suggests a gap in promoting and supporting progressive and egalitarian concepts such as a just transition in professional practice guidance.

CONCLUSION

The research that underpins the paper provides several unique insights suggesting the professions and their members could play an important role in communicating and advancing critical issues such as the climate crisis, decarbonisation and the just transition.

This research highlights the need for professional bodies in the UK associated with managing the public estate to continue providing thought leadership in relation to issues such as climate, decarbonisation and a just transition. There is however evidence that the generation of professional guidance has slowed following a peak in 2022, possibly signalling a saturation point or that there is nothing new to say.

It is also worth noting that the availability of professional guidance, which in some cases is restricted to full (paid up) members, is not consistent with open, integrated and whole system thinking, and could unintentionally support siloed thinking and fragmentation. It is recognised however that paid access is important for the professional bodies to sustain and remain independent from inappropriate influences. Arrangements for bridging between professions and sharing professional guidance more widely should be considered. A commonly adopted codification system for classifying guidance across the professions, such as that adopted by the RICS, would be beneficial, as there is evidence from this study to suggest that information is sometimes presented as professional guidance but is in fact not.

Ultimately the paper demonstrates an opportunity to communicate more clearly through professional practice guidance the role of the professions in supporting a just (intergenerational) transition, and that an opportunity now exists to improve joined up (collaborative) production of professional guidance by the professions involved in managing the built environment.

Areas identified for further research include understanding the linkages and interdependencies between issues such as maintenance (investment) backlogs, decarbonisation, mitigation, adaptation, asset resilience and achieving a just transition, as well as the different approaches adopted across jurisdictions outside of the UK.

AI DECLARATION

Litmaps employs AI to power its search algorithms and visualisation tools to help users identify relationships between papers. No other AI was used in preparing the paper.

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APPENDIX A

Table A 21 professional bodies recognised in the UK Government Property Career Framework

ID	Professional Body	Acronym	Number Documents	Validation Response
1	Central Association of Agriculture Valuers	CAAV	0	No
2	Chartered Institution of Building Services Engineers	CIBSE	3	No
3	Chartered Institute of Ecology and Environmental Management	CIEEM	0	No
4	Chartered Institute of Housing	CIH	10	No
5	Chartered Institute of Building	CIOB	1	Yes*
6	Chartered Institution of Wastes Management	CIWM	0	No
7	Chartered Institution of Water and Environmental Management	CIWEM	0	Yes
8	Energy Institute	EI	0	No
9	Institution of Civil Engineers	ICE	9	No
10	Institute of Environmental Management and Assessment	IEMA	0	Yes
11	Institution of Environmental Sciences	IES	0	No
12	Institution of Engineering and Technology	IET	0	Yes
13	Institution of Fire Engineers	IFireE	0	No
14	Institution of Fire Safety Managers	IFSM	0	Yes
15	Institution of Mechanical Engineers	IMechE	8	No
16	Institution of Occupational Safety and Health	IOSH	0	Yes
17	Institution of Revenues Rating and Valuation	IRRV	0	No
18	Institute of Workplace and Facilities Management	IWFM	0	No
19	Royal Institute of British Architects	RIBA	4	Yes
20	Royal Institution of Chartered Surveyors	RICS	8	Yes*
21	Royal Town Planning Institute	RTPI	2	Yes

"*" = recommended examining codes of conduct or professional standards for members in future research

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https://assets.publishing.service.gov.uk/media/62ab0341e90e070391963cc3/GPP_Career_Framework.pdf

Barriers and Success Factors of Condition-Based Maintenance for Sustainable Facility Management in the Public Sector

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ABSTRACT

Background and Aim. Condition-based maintenance is defined as a method that optimizes the utilization of resources for building upkeep by basing interventions on the actual condition of buildings, rather than relying solely on predetermined intervals as is the case with time-based maintenance. The management of public buildings and infrastructure requires significant allocation of state funds. Sustainable maintenance is therefore crucial. This study focuses on how public property managers operationalize condition-based maintenance (CBM) through strategies, processes, products and activities. The study identifies barriers and success factors for sustainable maintenance.

Methods and Data. The research examines three large public property managers in Norway using document studies and interviews. 10 semi-structured interviews are conducted with informants at strategic, tactical, and operational levels within the organizations.

Results. The findings highlight the importance of long-term maintenance plans, predictable budgets, and adapting strategies to specific building needs. The study identifies criteria for how condition-based maintenance can lead to more sustainable, targeted, and cost-effective property management if proper structures and processes are in place at the operative, tactical, and strategic levels.

Originality. The novelty of this paper lies in its focus on condition-based maintenance within the public sector. This study connects management levels and maintenance strategies by examining condition information and its communication value.

Practical Implications. The research has several practical and societal implications for facility management in the public sector, such as, improved resource allocation, enhanced decision-making, better communication and collaboration, sustainable practices, standard implementation, increased awareness, organizational improvement in long-term planning.

Type of Paper. Full Research

KEYWORDS. condition-based, FM, maintenance, public sector

INTRODUCTION

The management of public infrastructure requires significant allocation of state funds, as evidenced by the daily actions of the Norwegian Parliament and the public sector. The field of facility management within the public sector has seen considerable development with the emergence of specialized facility managers. The literature (Atkin & Brooks, 2021; Haugen et al, 2020) emphasizes the importance of a property manager understanding the relationship between strategy makers and maintenance implementers to reduce the gap between strategic and operational levels and improve information flow. Despite this, the literature reviewed (see the Literature study section) found less information specifically linking maintenance strategy to organizational structure, particularly the use of condition information at different organizational levels. There is also limited discussion on how

condition information and a condition-based maintenance strategy ensure that maintenance supports the users' activities in the building. This paper draws upon a Master's thesis that investigates how a condition-based maintenance strategy can contribute to effective and sustainable facility management in this context.

Condition-based maintenance is defined as a method that optimizes the utilization of resources for building upkeep by basing interventions on the actual condition of buildings, rather than relying solely on predetermined intervals as is the case with time-based maintenance. The paper aims to identify criteria that facilitate the successful integration of condition-based maintenance practices into the effective and sustainable management of property portfolios within the public sector. The central research questions (RQ) guiding this work is: *What criteria enable a condition-based maintenance strategy to contribute to sustainable facility management in the public sector?*

To answer the question, the study explored how public property managers plan and execute maintenance, comparing theoretical frameworks with the actual operationalization of condition-based maintenance through strategies, processes, products, activities, and follow-up within selected public property management organizations. The study also considered how maintenance actualizes various sustainability themes and how it can be adapted to achieve sustainability goals.

LITERATURE STUDY

The literature study covers concepts and terminology relevant to property management and maintenance. Buildings deteriorate gradually over time due to several reasons, including unattended defects, neglected damage, and natural causes. Hence, maintenance activities are required to impede the deterioration process to ensure the continuous function of the buildings. Maintenance is a systematic process to safeguard features and resources operated at optimum levels to achieve building standards and performance (Dzulkifli, et al, 2021).

Holistic lifecycle view

Managers tend to focus on a specific part of the system, instead of the system as a whole. A holistic view is more important than complex models and techniques (Ali & Abdelhadi, 2022). Atkin and Brooks (2021) note that while different management levels are often referred to as having different time perspectives in decision-making, this should not be the case. Instead, Atkins & Brooks (2021) suggest that investment in a new building would be considered operationally, and correspondingly that operational tasks will continue over a long period of time and must consider strategies and business plans. This emphasizes the importance of information flow between different management levels (Atkin & Brooks, 2021).

If a manager has established a methodology for measuring technical condition, they have a good starting point for further work. Managers must also have an opinion on established condition, whether it is good or poor. For such an assessment, there is a need to establish a reference to compare against. Once the reference level has been set, a manager needs to hire people and obtain equipment to carry out the measures so that the desired condition is achieved and maintained. Together with a maintenance strategy for how the maintenance should be carried out, resources and reference form the basis for a maintenance policy. It is not possible to carry out maintenance measures in a good way without these three conditions being assessed (Lee & Scott, 2009).

A comparative study from 2007 and 2018 found some improvement in the level of maintenance backlog and technical condition (Støre-Valen, M., 2021). The average condition grade was improved from 1,43 to 1,39 in 2018 (scaling from 0 (best) to 3 (worst)). Also, 67% of studied municipalities stated that the quality of the property management services was good or very good in 2018, while in 2007 25% stated the same. The results indicate that the success for good property management is a systematic approach to preventive maintenance and a long-term plan to amend the maintenance backlog, organizing the competences in multidisciplinary teams (Støre-Valen, M., 2021).

Value management has been introduced to construction projects, real estate and facility management business during the last decades. The long lifecycle of buildings and constant change in users' needs suggest that the concept of value and value management should be focused on users' as well as owners' needs to maximize the value creation and capture. An understanding of the concept of value for users and owners of buildings will contribute to successful projects, sustainable buildings and greater value creation (Haddadi et al., 2016).

Consulting Engineers' Association Norway assessed Norway's public buildings, facilities, and infrastructure (RIF, 2021). The report revealed a substantial maintenance backlog in municipal buildings, with a 160 billion NOK estimate in 2021, impacting functionality and the indoor environment (RIF, 2021). It also highlighted a lack of preparedness for climate change among municipalities, with almost 90% lacking systems to assess building vulnerability to climate-related impacts (RIF, 2021). The state-owned building stock managed by "Forsvarsbygg" and "Statsbygg" was also analyzed. The technical condition of Forsvarsbygg's portfolio is placed at the average, while Statsbygg's portfolio is generally assessed higher. The exception applies to Statsbygg's prison portfolio, which has been given a poor condition grade and a "red light". The total upgrade need for other state buildings is NOK 11 billion. Both Statsbygg and Forsvarsbygg have implemented maintenance and development measures in line with the strategy of value-preserving and condition-based maintenance. The challenges ahead lie in improving land use efficiency and stimulating environmentally sound management, operation and maintenance (RIF, 2021).

It will be challenging to reduce and restructure energy use while simultaneously safeguarding cultural, historical, environmental and aesthetic requirements. Government buildings are largely influenced by political decisions, while NATO requirements are crucial for defence buildings. It is recommended to establish a political strategy for public property management that ensures contributions to climate goals and a requirement to make the consequences of investments visible through life cycle analyses. Also, contingency plans for handling extreme situations should be seen more closely in relation to the flexibility in the use of buildings. The experience from the Corona pandemic, with new digital work processes and interaction surfaces, can be a strong contribution to improving land use efficiency and the joint use of existing areas (RIF, 2021).

Strategies and implementation

A key distinction exists between proactive and reactive maintenance. The typical reactive maintenance strategy is failure-based maintenance where maintenance is carried out when the failure occurs. Proactive maintenance involves maintaining before failure occurs and includes subcategories like predictive maintenance and condition-based maintenance. Predictive maintenance aims to foresee maintenance needs, either through diagnostic condition analyses or prognostic calculations based on various parameters (Gackowiec, 2019). The ambition is to anticipate the need for maintenance. This can again be divided into two ways of anticipating this maintenance need. Either by carrying out condition analyses (diagnostic) or by using forecasts based on various parameters (prognostic) (Gackowiec, 2019). Condition-based maintenance specifically uses thorough analyses at regular intervals to assess maintenance needs. The Norwegian Standard NS-EN 13306:2017 lists various forms of maintenance, including predictive and condition-based approaches (NS-EN 13306:2017).

The ability to connect building management to user needs is one of the greatest challenges for a manager. A manager who fails to meet new user needs risks ending up in a position of controlling buildings rather than managing them. The manager will also find it difficult to defend his or her own value (Loosemore & Hsin, 2001). Property management is typically broken down into the concepts of management, operation, maintenance, development and service. Public property management often involves three main roles: owner, manager, and user (Haugen, T. et al, 2020). These roles can be integrated or separate entities. Within the public sector, major managers like "Statsbygg" and "Forsvarsbygg" were established as separate entities to achieve greater specialization and efficiency.

Public property managers primarily handle purpose-built buildings, which are specialized and have few alternative uses.

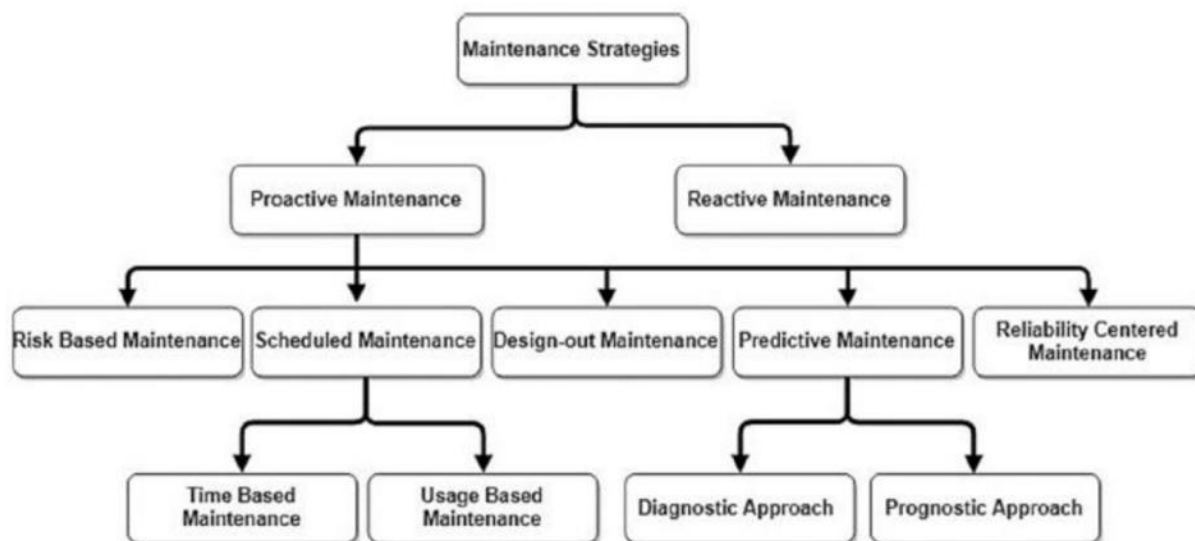


Figure 1 Classification of maintenance strategies (Gackowiec, 2019)

A maintenance policy is crucial for effective maintenance work. It describes how an organization defines maintenance for its portfolio. Establishing a maintenance policy requires considering three elements: maintenance standard (reference level), maintenance resources (personnel, equipment), and maintenance strategy (how maintenance is performed). A maintenance strategy is a concretization and continuation of the property unit's overall strategy and goals for how the building stock should serve the organization. For larger property managers, developing a maintenance plan is a natural progression from the policy (Lee & Scott, 2009). Condition analysis is presented as a measurement tool. While historically focused on technical condition, newer literature introduces methodologies that incorporate users' perception of condition and a building's utility value, linking these measurements to sustainability. Standards exist for mapping buildings and installations. The BREEAM In-Use certification scheme rewards good maintenance routines, principles that avoid errors, and systems that predict when maintenance should occur, BREEAM In-Use recommends a strategy based on preventive maintenance (to avoid failure) and predictive maintenance (to determine condition to predict maintenance needs). Both condition-based and predictive maintenance align with BREEAM's recommendations (BRE Global, 2020).

Operationalization and methodology

So far, condition analyses have had a technical starting point with a main emphasis on service life and material quality. In a new standard from 2023 (NS-EN 17680; Sustainable buildings - Evaluation of the potential for sustainable rehabilitation of buildings), a new way of assessing buildings is introduced. In line with sustainability goals related to green transition and circular economy, this standard introduces the method for assessing whether it is appropriate to renovate/rebuild the building or whether it is better to demolish and build new. This standard uses a specific assessment model to assess the viability of buildings. Here, buildings are assessed on two axes, adaptability and suitability. Adaptability in this context is the building's ability to adapt to various changes that occur. This may include changed requirements for interior use and adaptations to changed external factors such as requirements for roof load-bearing capacity, the possibility of wider doorways, etc. Suitability is about the building's ability to support the business that uses the building.

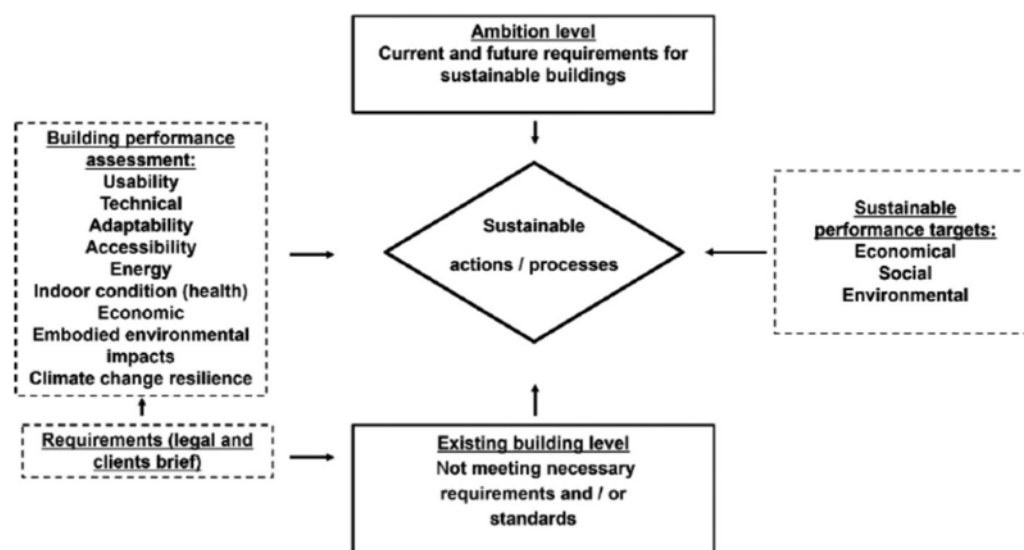


Figure 2 Sustainable actions/process for choosing whether to transform or maintain a building (NS-EN 17680, 2023)

Using condition analyses and the Viability model in a lifecycle perspective involves little to no maintenance in the early years, followed by a period requiring monitoring and assessment (e.g., condition analyses every five years), and eventually assessments of functionality and adaptability as the building ages and user needs change. Such assessments are important for avoiding waste and achieving cost-effective property management (NS-EN 17680:2023).

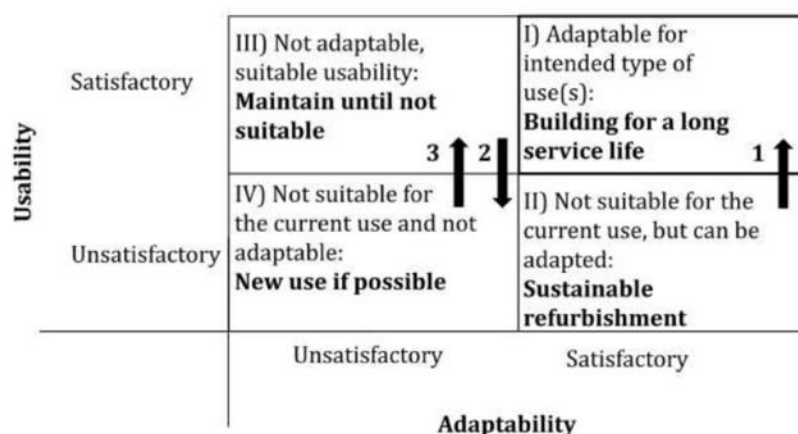


Figure 3 Choosing strategies for buildings based on usability and adaptability (NS-EN 17680, 2023)

The recast of Energy Performance of Buildings Directive (EPBD) 2018/844/EU introduced in the article 19a the possibility of building renovation passports which provide a long-term and step-by-step deep renovation roadmap for a specific building. Preliminary results showed that optimisation models for deep renovation of existing building almost exclusively optimise single stage retrofitting. Different from the single stage approach, in the step-by-step approach the retrofitting measures are not performed at the same time. The single stage retrofitting measures could be broken down in different renovation steps over a period of several years or even decades. Certain criteria should determine the time-wise prioritisation of the retrofitting measures (Maia&Kranzl, 2019).

Communication

Effective communication and interaction between manager, owner, and user are highlighted as success criteria for achieving and maintaining high sustainability performance and certification levels and for successful operation of internal rental schemes, ensuring the building's environmental

performance, user well-being, and overall management meet desired standards and ratings. This communication should include long-term maintenance plans that are systematically updated and easily accessible. BREEAM In-Use awards points for structured dialogue with users and the local community, exchanging information on building performance, routines, and environmental matters. When property management is separated into its own entity, a greater distance between user and manager can arise, particularly affecting communication. Effective communication is crucial across different management levels: strategic (policy, guidelines), tactical (contracts, terms), and operational (daily dialogue on delivery). User competence in specifying needs at tactical and strategic levels is also noted (BRE Global, 2020).

METHODS AND DATA

The studied organizations were Forsvarsbygg, Statsbygg, and Oslobygg. Statsbygg and Forsvarsbygg are state-owned entities, while Oslobygg KF is municipally owned. The selection of organizations for the study was done to include those who actively utilize a Condition-Based Maintenance (CBM) strategy. The purpose of the study was to identify criteria for how condition-based maintenance can contribute to effective and sustainable management of property portfolios. The selection of the three public-sector organizations was based on their status as large public-sector facility managers and their relevance to the research scope. The researchers chose these specific entities because their size and magnitude mean they face complex management challenges and risk losing sight of external realities, making them suitable for comparative analysis and benchmarking studies on maintenance practices.

The selection of public buildings for the study was driven by several key factors. Public buildings represent a significant portion of the public's common assets, leading to high public interest in their appearance and management. There is considerable engagement regarding how these buildings look and are managed. Further, the Norwegian Parliament and the public sector allocate substantial state funds daily for various purposes, including the upkeep of public infrastructure and the maintenance of public buildings. Also, there are widely discussed issues of lack of maintenance and significant maintenance backlogs, particularly for public buildings. This context underscores the importance of finding effective strategies for managing these properties.

The research design employed in the original thesis was based on a qualitative approach using two primary methods: document analysis and qualitative interviews. This approach aligns with a phenomenological philosophy, seeking to understand the subjective experiences and perspectives of individuals working in public property management concerning condition-based maintenance. The approach is inductive, exploring the phenomenon to gain understanding. The study used data triangulation by combining these two qualitative data sources. The document study analyzed relevant official documents from selected public sector organizations and their owners, including annual reports, financial statements, steering documents (like allocation letters), and strategies (business, environmental, sustainability). These documents provided insights into the organizations' reality perception, official stances, values, and political will over time. Specific terms like "condition" and "value-preserving" were searched for, and content analysis and critical discourse analysis were applied to interpret the information and understand the values and attitudes being conveyed. The analysis aimed to see if there were consistent awareness and reflection on the topic in public presentations.

Qualitative interviews were conducted with key stakeholders within the selected organizations. A total of 10 interviews were conducted on all three organizational levels (strategical, tactical and operative) for each of the three public building managers. For Oslobygg, an additional interview was conducted at operational level. This method was chosen to gather detailed, comprehensive information, opinions, attitudes, and experiences related to condition analyses and condition-based maintenance. Interviews provided insight into informants' reality perception at their respective management levels: strategic, tactical, and operational. Informants were selected based on the research questions and organizations, aiming for a representative sample across different

management levels within each organization, while also targeting individuals with significant knowledge and central positions in maintenance work. A quota sampling approach was used, with one or more informants selected for each category (organization and management level). The interview data was processed using techniques inspired by a concept of interview analysis as bricolage, including identifying themes, patterns, and visualizing findings (Kvale, S. et al., 2015).

The interviews were semi-structured in form using an interview guide with fixed questions on specific matters. At the same time the interviews were facilitated to have an informal style, so that the informants had the opportunity to go into depth about their experiences and perceptions. The informants were chosen based on their (relevant) background and position in the businesses. The questions were divided into the following four main categories with detailed sub-questions: Background questions (role, work experience, responsibilities and tasks), Condition-based maintenance (definitions, tools, scope, use of technology), Use of technical condition analyses (different levels, decisions, strategy, tools, benchmarking), Future CBM (reflections).

The Method critique addresses aspects of quality. Document studies are considered more reliable than interviews due to their fixed form, but interpretation is still necessary. Detailed method description and thorough data evaluation are used to increase reliability. Combining two methods allowed for cross-validation of findings to enhance credibility. Detailed method and finding descriptions were provided to help readers assess transferability. The researchers being employees in one of the studied organizations is acknowledged, and reliance on theory and open method description are used to ensure an ethical and objective approach. Ethical considerations were addressed, including managing potential bias from the researchers' affiliation, obtaining informed consent from interviewees, protecting anonymity, and ensuring the research topic was viewed as societally beneficial.

RESULTS

The results are derived from the analysis of documents and interviews across Forsvarsbygg, Statsbygg, and Oslobygg.

Overview of Technical Condition

All three organizations utilize condition analyses as a basis for maintenance planning. The definition of maintenance varies among informants, though strategic levels often reference Norwegian Standard definitions. Tactical and operational levels often focus on preventing the deterioration of technical condition or meeting economic thresholds. Oslobygg is the only organization that reports both the ambition for technical condition and the actual condition grade in its annual report. Statsbygg reports minor to moderate deviations except in specific portfolios. Forsvarsbygg's documents did not specify a target condition grade. Digital solutions are used for storing and managing condition analysis data, but they vary between organizations (e.g., MultiMap, MMFM, and systems described as less suitable for detailed analysis). Some organizations still rely partly on manual methods like Excel. The methodology for conducting condition analyses differs. Forsvarsbygg uses internal resources and engineers, noting findings on paper before entering them into the system, and update frequency is not always consistent with guidelines. Statsbygg primarily uses external resources via framework agreements but plans to reduce the number of contractors to ensure greater consistency. Oslobygg uses external resources for complete initial analyses and then conducts annual portfolio updates with internal resources via a "desk exercise". Access to condition analysis information varies. Oslobygg and Forsvarsbygg state that all employees have access, while Statsbygg limits access to those cleared to see the properties. The perception of whether condition analyses provide a sufficient basis for detailed planning and ordering of maintenance work differs. Operational level informants in Forsvarsbygg and Oslobygg indicate that Level 1 analyses are often insufficient for detailed task description, requiring further investigation or functional descriptions.

Use of Condition Information in Communication

The management levels (strategic, tactical, operational) are recognized concepts in the interviews, though less explicitly used in organizational documents. Condition information is perceived as having significant value in communication with users, particularly at tactical and strategic levels. Statsbygg, in particular, has focused on strengthening customer dialogue. Oslobygg stands out by incorporating the viability model principles in its dialogue with users, categorizing buildings based on condition, suitability, adaptability, and long-term need. This links condition analysis results to the user's core activities. While the importance of user dialogue is noted in external reports and certification schemes, the consistency of this dialogue varies among the studied organizations. Condition analysis information, especially regarding consequence grade, is relevant to users as it indicates potential impacts on their operations. E.g. Forsvarsbygg is established as the "property expert advisor" for the defence sector, aiming to provide comprehensive property advice in cooperation with users. This role involves challenging users while ensuring cost-effectiveness, sustainable resource utilization, and meeting user needs within budget. Prioritization for User Needs: When extraordinary maintenance funds are allocated, the owner specifies that these funds should be used where they are most critical and provide the greatest effect for users. This implies that condition data can inform which areas have the greatest need, though the process for determining "greatest effect" and the specific dialogue responsibility is not clearly detailed. Despite its advisory role and the importance of user needs, interview findings indicate that Forsvarsbygg generally does not utilize detailed condition information directly in its dialogue with users. Instead, discussions with users primarily revolve around maintenance plans, without significant emphasis on the underlying condition analyses. This suggests a gap in how detailed technical condition data is translated and communicated to users to inform their understanding and prioritization.

Strategic and External Factors

Owner directives strongly influence the use of condition-based maintenance. For Statsbygg and Oslobygg, allocation letters explicitly mandate using condition analyses and pursuing value-preserving maintenance. Forsvarsbygg's directives emphasize condition assessments according to standard, but with a focus on utility value rather than explicitly mandating condition-based maintenance as the primary strategy. External audits, like those by the National Audit Office (Riksrevisjonen) concerning Forsvarsbygg, have highlighted the need for improved steering dialogue regarding maintenance prioritization and incorporating user needs into the assessment methodology. Reports from consultants have underscored the importance of a maintenance strategy and underlying documentation, noting potential for improvement in communication between users (sometimes perceived as less professional clients) and managers.

Oslobygg categorizes its buildings based on a combination of technical condition, consequence grade, viability, suitability, and adaptability to prioritize maintenance. Buildings with good condition, suitability, adaptability, and long-term need are prioritized to maintain their status, while poor buildings have a lower accepted condition level and are not prioritized for general maintenance. Direct external influence from media or interest groups on maintenance prioritization appears limited, but indirect influence via political levels can occur, often accompanied by dedicated funding.

DISCUSSION

This study explored how a condition-based maintenance strategy can contribute to good property management in the public sector, focusing on how organizations ensure an overview of technical condition, how condition information is used in communication, and identifying success criteria.

Regarding overview of technical condition (Research Question 1), the findings confirm that having a systematic overview of the building portfolio's technical condition is fundamental for condition-based maintenance, as emphasized in the literature. All studied organizations employ condition analyses, albeit with varying methodologies and update frequencies. The difference in update frequency (e.g., Oslobygg's annual update vs. Forsvarsbygg's less frequent approach) raises questions about the timeliness and quality of information for decision-making. While Level 1 analyses provide a necessary overview for strategic and tactical planning, operational levels often require more detailed

information, necessitating further investigations or specific functional descriptions as noted by Forsvarsbygg. This suggests that while the standard condition analysis provides valuable high-level information, operational execution requires additional, more detailed data collection or analysis for specific interventions.

The effectiveness and cost-efficiency of different approaches to updating condition information (e.g., full analysis vs. desk exercise updates) remain open questions. Ensuring efficient use of the large amounts of data generated requires appropriate digital systems, which some organizations are in the process of acquiring. Concerning the use of condition information in communication (Research Question 2), the study found that while the concepts of strategic, tactical, and operational levels are understood, their explicit use in organizational documents is less common than in theoretical literature. Condition information is indeed used in the interaction between owner, manager, and user, particularly valued in dialogue with users at tactical and strategic levels. The literature review highlighted a gap in explicit connections between maintenance strategy, organization, and the use of condition information across levels. However, the interview findings indicate that condition information, especially when aggregated for areas or portfolios, can be valuable in structured user dialogue.

Oslobygg's adoption of principles, like the viability model, linking technical condition with suitability and adaptability based on user needs, represents a concrete way condition information can support user-centric decisions. This aligns with theoretical emphasis on structured user dialogue in good property management and sustainability certifications. The relevance of consequence grade information from condition analyses for users underscores the importance of sharing this data across levels and with users. Identifying success criteria for condition-based maintenance contributing to good property management (Research Question 3) involved synthesizing findings from the literature and interviews. Based on this synthesis, key criteria emerged: Overview of technical condition, Long-term maintenance plans, Communication and interaction between actors and management levels, and Predictable multi-year budget plans for maintenance.

Overview of technical condition is the acknowledged foundation. Consistent, quality, and accessible condition information is essential for prioritization by both manager (technical reasons) and user (core activity needs). The frequency and methodology of updates impact the quality and timeliness of this information. Long-term maintenance plans, supported by updated condition information and predictable budgets, enable realistic planning over time, which is particularly valuable for public sector users with long-term occupancy intentions. Communication and interaction (between owner, manager, user, and across levels) is crucial for aligning maintenance efforts with organizational goals and user needs. Structured dialogue mechanisms enhance the value of condition information.

Predictable multi-year budget plans are necessary to execute planned maintenance derived from condition analysis and long-term plans, facilitating stable and effective property management. External reports also link economic resources to challenges in municipal property management. The study's findings corroborate many points from the literature regarding the importance of condition information, strategic planning, and communication. The variations in how organizations implement condition-based maintenance and utilize the resulting information highlight different approaches and potential areas for improvement, particularly concerning the level of detail required at operational levels and the consistency and accessibility of information.

Maintenance practices play a crucial role in actualizing various sustainability themes and can be adapted to support broader sustainability goals, especially within public sector property management. This can be achieved e.g. by utilizing existing buildings through maintenance and rehabilitation instead of new construction, replacing older components with energy-efficient alternatives, employing environmentally friendly materials that can be decomposed and reused, achieve or exceed the expected lifespan of the building components. Further, maintenance can involve adapting building elements to prevent climate-related damage, for instance, by installing more robust cladding designed to better withstand heavy rain.

Good property management, underpinned by effective maintenance, aims to improve people's quality of life and the productivity of core businesses within built environments. To effectively integrate sustainability, maintenance practices can be adapted through adherence to standards and certifications, strategic Planning and Management, effective communication and dialogue and implementation of leveraging Technology, e.g. sensors and predictive maintenance systems allowing for real-time monitoring of building components.

CONCLUSIONS

This paper, drawing on the provided sources, explores how a condition-based maintenance strategy contributes to improved property management in the public sector. The central research question was *"What criteria enable a condition-based maintenance strategy to contribute to sustainable facility management in the public sector?"* Based on the analysis of documents and interviews with public property managers, it can be concluded that a condition-based maintenance strategy is a valuable approach that can substantially contribute to effective facility management provided that certain criteria are met. While the implementation varies across organizations, the strategy fundamentally relies on basing maintenance decisions on the actual condition of buildings. Key criteria identified for a condition-based maintenance strategy to contribute to sustainable property management are:

- 1) Updated condition information: Sufficient, high-quality information, updated frequently (at least upon significant changes), is necessary for informed decision-making.
- 2) Defining the need for condition information at different management levels: Awareness of the utility of condition analyses across operational, tactical, and strategic levels is needed, and analyses must be delivered in a format suitable for management systems.
- 3) Learning from best practice: Comparing approaches with other organizations and benchmarking can enhance competence in maintenance.
- 4) Implementing the Viability model: Using standard NS-EN 17680 to map suitability and adaptability is essential for relevant long-term plans.
- 5) Long-term maintenance plans: Essential for planning maintenance over time based on condition information.
- 6) Communication and interaction between actors and management levels: Crucial for aligning maintenance with needs and strategies.
- 7) Predictable multi-year budget plans for maintenance: Necessary for consistent execution of planned maintenance.

Ultimately, successful condition-based maintenance requires not only good condition reports but also robust methodologies for planning, financing, and communicating maintenance actions. The value of condition information as a management tool needs to be widely recognized and adapted for different levels and stakeholders. The future of maintenance may increasingly involve predictive approaches leveraging real-time monitoring and digital tools, building upon the principles of condition-based assessment. Further research could investigate the specific information needs at different management levels and how condition information can best be used in user dialogue to optimize utility value.

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AI DECLARATION

AI has been used to summarize and systematize some of the text in the article.

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From Identification to Practitioners' Assessment: Factors Influencing Corporate Real Estate Management Performance in Saudi Arabia

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ABSTRACT

Background and Aim. The performance of corporate real estate management (CREM) is a complex process involving the alignment of different resources and activities, meaning that it is influenced by different factors. Knowledge about these factors and their significance in practice remains under-researched. This paper aims to identify and assess the factors influencing the performance of CREM.

Methods and Data. An integrative approach of theory and practice was followed. First, the factors influencing the performance of CREM were inductively identified through a literature study. Second, a questionnaire was developed and conducted to deductively test the significance of the identified factors from the perspective of 33 CRE practitioners in the Eastern Province of Saudi Arabia, using the relative importance index as an assessment indicator.

Results. The literature study identified 33 factors and categorized them into four groups, namely: managerial affairs; physical and spatial aspects; economic and financial aspects; and the real estate market. The questionnaire results indicate that the availability of management plan(s) and strategy of the business, availability of a plan for facilities planning and management, the structural integrity of the properties, and the occupancy (supply and demand) indicators have been perceived as the most influential factors.

Originality. The paper contributes to bridging the gap between the theory and practice of CREM by defining the factors influencing the process, followed by empirical evidence of their significance.

Practical Implications. The results provide CRE practitioners with a knowledge base to enhance CREM.

Type of Paper. Full Research

KEYWORDS. built assets, corporate real estate management, CRE, property management, strategy.

INTRODUCTION

Corporate real estate (CRE) is a wide term used in corporations, referring to the real property held by public or private organizations (Oluwoye *et al.* 2001). Corporate real estate has grown in response to the concomitant changes of the industrial revolution in the 20th century, in which many firms (non-real estate firms) have begun constructing a huge number of accommodation buildings (Krumm 2001). It has also received momentum in the 21st century, following the financial crisis in 2008 (Glatte, 2021). CREM can be described as “*all property-related activities of a company whose core business is not real estate. CREM deals with the economic procurement, support, and utilization of the properties of production, trading, and service companies as part of their corporate strategy. The properties serve to carry out and support the core activities.*” (Pfnür, 2014).

CREM concerns the management of buildings and parcels of land at the disposal of a private/public organization that is not mainly involved in the business of real estate (Bon 1992), also known as non-property organizations (Glatte, 2021). Hence, CREM comprises a wide range of managerial activities pertaining to portfolios, spaces, buildings, and land holdings, including planning and management of investment, planning and management of financial affairs, planning and management of construction, and planning and management of facilities (Bon 1998). It has evolved to involve the strategic alignment of these processes and resources in a manner contributing to the organizational effectiveness and efficiency (Wijnja et al., 2021). However, several factors affect the CREM in terms of the asset management in an adverse as well as a positive manner (Veale 1989). Thus, the performance of CREM needs to be comprehended, measured as well as assessed in any organization involved in the real estate business, to achieve the success of the organizational goal (Bon et al. 1994).

Measuring and assessing the corporate real estate performance conceptually refers to the linkage between the strategic goal and the operational status of the real estate in an organization (Nourse 1994). The key goal of measuring the performance of real estate is to assess the progress of the real estate function compared to the main business objectives desired to be achieved (Varcoe 2002). However, several measurement techniques are used to measure the CREM performance, where the perfect techniques would have higher potential in terms of realizing the strategic goals of the business in an organization (Jordan et al. 2009).

However, the performance of the CREM is influenced by several factors from different aspects (Pittman and Parker 1989). Based on a review of relevant literature on CRE and real estate management (REM), we found that few studies have focused on the investigation of the factors that influence the performance of CRE and CREM in a comprehensive manner. Consequently, the goal of this paper is to investigate the factors that influence the performance of CREM and their significance from the perspective of practitioners.

This paper is a literature- and questionnaire-based study. It aims to answer the following research question: What are the factors that influence corporate real estate management performance, and what is their significance in practice? The involved sample is practitioners of CREM in the Dammam Metropolitan Area in the Eastern Province of Saudi Arabia. The development of the survey was based on a literature review as well as pilot testing by local experts. The relative importance index (RII) was the statistical technique used in analyzing the obtained data from the survey.

RESEARCH METHODOLOGY

The research methodology followed in this paper used literature review and a questionnaire, respectively, as research methods and comprised the following six activities:

- 1) Review published literature relevant to corporate real estate (CRE) and real estate management (REM) to identify factors affecting the performance of corporate real estate management
- 2) Develop a questionnaire to assess the factors affecting CREM performance in Saudi Arabia.
- 3) Conduct a pilot study with local CREM practitioners to validate the questionnaire readability.
- 4) Distribute the developed questionnaire to different practitioners of CREM in the Dammam Metropolitan Area, Saudi Arabia. To obtain valid and relevant responses, the respondents were selected based on purposive sampling – a non-probability sampling technique used to involve respondents associated with a certain domain and knowledge (Rahman, 2023; Tongco, 2007).
- 5) Analyse the data received by calculating the relative importance index (RII), then rank the factors in ascending order based on their RII.

The questionnaire was adopted as the primary empirical research method in this paper. It was developed to assess identified factors from the reviewed literature. The survey was both paper-based and online. It was distributed between 2019 and 2023. As purposive sampling was used – a non-

probability sampling technique involving respondents associated with a certain domain and knowledge (Rahman, 2023; Tongco, 2007), the questionnaire was distributed among different practitioners managing and operating organizational real estate (CRE). We did not limit our respondents to a specific organizational context, as the focus was on CREM performance as a theme of interest. We also approached respondents from the Dammam Metropolitan Area because of our connections with a wide range of CREM professionals.

The developed survey was divided into three sections: Section A – General Information, Section B – Evaluation Sheet, and Section C – Additional Remarks. Section A was the introductory section. It consisted of two parts: a summary and personal information. The summary section includes a brief overview of the study and its purpose. The personal information section covered demographic questions about the personal profile of the respondents, including name, organization, organization address, job title (position), and number of years' experience with corporate real estate management.

Section B covered an assessment sheet of the identified factors. The factors were sorted in a tabulated format, where the respondents were asked to indicate the importance rate of each factor using a 5-point Likert scale evaluation scheme, namely "Extremely Important", "Very Important", "Important", "Somewhat Important", and "Not Important". Section C was an optional section. It was provided to enable the respondents to add any comments based on their professional experiences.

The relative importance index (RII) was the statistical technique used to analyse the findings of the received responses, due to its provision of a quantified weighted indicator leveraging multiple responses to Likert-scale questions (Holt 2014). It was calculated to determine the significance rate of each factor in terms of its influence on the performance of corporate real estate management. RII was calculated with the help of Microsoft Excel (365), by applying the following equation (Dominowski 1980):

$$\text{Relative Importance Index (RII)} = \frac{\sum_{i=0}^4 (a_i)(X_i)}{(4 \sum X_i)} \times 100$$

Where:

- i: Response category index where i = 0,1,2,3,4
- a_i: Weight given to i response where i = 0,1,2,3,4
- x_i: is the variable expressing the frequency of i

All importance levels have been given a specific variable expressing the frequency (x_i) that indicates their level of significance. Similarly, a specific weight (a_i) for each importance level was given. To have an interpretative qualitative description of the RII calculated, each importance level was given a particular class width (importance rate). Table 1 demonstrates the adopted variables expressing the frequency, weights, and importance rates for all importance levels. Based on the received RIIs, the factors were ranked from most to least important to show the perceived significance.

Table 1 Adopted variables expressing the frequency, weights, and importance rates

Importance Level	Variables Expressing Frequency (x _i)	Weight (a _i)	Importance Rate
"Extremely Important"	x0	4	87.5 - 100%
"Very Important"	x1	3	62.5 -< 87.5%
"Important"	x2	2	37.5 -< 62.5%
"Somewhat Important"	x3	1	12.5 -< 37.5%
"Not Important"	x4	0	0 -< 12.5 %

LITERATURE STUDY

A generic literature study was conducted to identify and categorize the factors affecting the performance of CREM. It is worth noting that the process of obtaining the literature sources was not systematic, but rather theme-specific, focusing on a broad range of publications related to CRE, CREM, CRE performance, and the management of organizational real estate. The reviewed sources include books, peer-reviewed articles, and theses. Some of the books were already available. Google Scholar was used to obtain the digital sources, using the terms "corporate real estate", "corporate real estate management", and "corporate real estate performance". The factors were iteratively identified during the review process and grouped under four categories, namely: "factors related to managerial

affairs”, “factors related to physical and spatial aspects”, “factors related to economic and financial aspects”, and “factors related to the real estate market”.

Based on this literature study, we identified 33 factors that can influence the CREM performance. We grouped them into four groups – related to managerial affairs, physical and spatial aspects, economic and financial aspects, and the real estate market – to comprehensively consider the interrelated aspects relevant to processes, built assets, and the property market on different levels.

Factors related to managerial affairs

These factors affect CREM performance from an administrative angle. Nine factors were identified:

- 1) Clarity of the identified goal(s) of the real estate business: Clear identification of the organization's real estate goals is essential for CREM (Pittman and Parker 1989). Goals must align with overall organizational strategy (Bon et al. 1994). CRE may serve either investment or operational objectives (Edwards and Ellison 2009). These goals can change during the holding period (Downs Jr. 1980). Thus, real estate goals should be strategically defined and tracked.
- 2) Availability of management plan(s) and strategy of the business: Strategic management enhances real estate business performance (Edwards and Ellison 2009). Management plans guide property supervision in physical and financial terms (Downs Jr. 1980), covering portfolios, land, construction, and facilities (Bon 1994; Musa and Baharum 2012). A strategic approach improves effectiveness (Ridzuan 2012), while advanced tools enhance planning (Fayomi 2023). Thus, a management plan coordinating activities is vital for portfolio performance.
- 3) Computerized inventory of all properties and assets: A digital inventory strongly influences CREM performance (Pittman and Parker 1989). Technology enhances asset management (Roberts et al. 2018), making computerized property data a critical factor.
- 4) Availability of a plan for facilities planning and management: The subject of facilities management (FM) has a direct connection with REM. Many professional organizations concerned with FM have developed models and tools aligning the FM processes with the property operation, because of the added value by such alignment (Ebinger and Madritsch 2012). This can be attributed to the potential role of FM in improving productivity by facilitating the provision of spaces accommodating organizational activities (Jensen and Voordt 2021).
- 5) Encouraging and rewarding personnel for excellence and achievement: Human resources are one of the key components that shall be considered in the CREM (Oluwoye et al. 2001). Having a motivation to personnel's excellence and achievements – realized by improving the knowledge and skills through the education and training programs – is considered a factor that could enhance the performance of CREM (Pittman and Parker 1989). This also can include providing an aligned workplace supporting the employees' well-being, behaviors, and their human-related needs (Wäistö et al. 2024).
- 6) Availability of well-defined performance measurements used for the assessment of the real estate business: Well-defined performance measures help assess CREM (Pittman and Parker 1989). Several systems exist (Jordan et al. 2009), and organizational models include CREM functions (Hartmann et al. 2010). Measures compare performance with objectives (Varcoe 2002), requiring data such as revenue, rent, value, costs, and yields (Edwards and Ellison 2009).
- 7) Availability of a record of estimated prices of all properties and assets: Despite the direct influence of the availability of the computerized inventory of all properties and assets on the performance of CREM, the market values of these properties are also considered an important factor in the CREM (Pittman and Parker 1989). Value and size of assets are factors affecting the performance of the CREM in terms of asset management (Kaluthanthri 2014).

- 8) Availability of regional data and statistics about the economic and demographic trends: Understanding the economic regional context and its impact on the business is important for strategic property management (Edwards and Ellison 2009). Information about property prices, occupancy levels, and population trends is important for property planning and management.
- 9) Maintenance and renovation: Managing maintenance and remodeling activities is within the scope of work of the property managers (Downs Jr. 1980). From the perspective of corporate real estate, the increase in complexity as well as the number of real properties held by an organization increases the need to maintain and operate these properties in a proper way (Krumm 2001). The maintenance of built assets is also one of the concerns of CREM practitioners, because of its vital role in keeping property performing in line with the desired performance (Bon et al. 1994). Thus, FM can be an effective means to add value to the built assets by providing services for maintaining property operation (Jensen and Voordt 2020).

Factors related to physical and spatial aspects

These factors concern property attributes and location. Eight factors were identified:

- 1) Location of properties: Location is one of the most important factors in real estate, as it represents the principle of land (Downs Jr. 1980). Selecting the location of a property is crucial as it impacts its performance (Rymarzak and Sieminska 2012). Corporations owning properties in suitable locations can generate profits in case of a recession (Krumm 2001).
- 2) Relation between the properties and the surroundings: Despite the importance of the location of properties in real estate management, the relation between properties and the surrounding environments is an important factor (Downs Jr. 1980). Numerous aspects fall under this factor, including neighbourhood boundaries, land use, and building design (Edwards and Ellison 2009).
- 3) Ownership status of properties: Ownership of properties is considered one of the concerns that needs to be looked into in the domain of CRE, as it can influence the value of corporations; in many situations, it can be a risk to a corporation's financial affairs (Graham et al. 2014).
- 4) Structural integrity of the properties: Survey and evaluation of the physical structure of buildings are principal factors in the planning of CREM (Edwards and Ellison 2009). Further, maintaining the physical condition of these built assets in a safe manner to protect their users is one of the key responsibilities in the profession of real estate management (Downs Jr. 1980).
- 5) Age of properties: In addition to the survey of the physical condition of properties, information about the age (or what is known as the physical life) of buildings is an important determinant in CREM (Edwards and Ellison 2009). In fact, the age of a property influences its management plan, as the age can affect the desirability and attractiveness of the built assets (Downs Jr. 1980). Property age is also a factor that has other influences on the property management in terms of operational performance, such as energy consumption (Surmann et al. 2016).
- 6) Design and layout of properties: Design of properties is also a factor that influences the management plan of property in terms of its attraction as well as desirability (Downs Jr. 1980; Assaf et al. 2010). Different aspects are considered under this factor, including boundaries, site, and size of the property (Edwards and Ellison 2009). For instance, the layout of the workplace plays a pivotal role in productivity and knowledge exchange; therefore, CREM practitioners should take design aspects into consideration (Appel-Meulenbroek et al, 2013).
- 7) Services and amenities offered within properties: Services and amenities, such as equipment, MEP systems, offered within a property play a role in the value of properties (Downs Jr. 1980; Halvitigala and Reed 2015). For instance, previous research has revealed that ICT services can play a key role in adding value to an organizational workplace due to their potential to enhance workers' productivity (van der Voordt and Jensen, 2021).

- 8) **Vacancy level of properties:** The vacancy level (also known as vacancy ratio) is one of the operational measures that can be used to identify the performance of CREM (Varcoe 2002). It is one of the determinants in the law of supply and demand applied in the real property profession. It refers to the percentage of the unoccupied property units (Downs Jr. 1980). Moreover, it can affect the selection of property location (Rymarzak and Sieminska 2012).

Factors related to economic and financial aspects

These factors relate to financial conditions at the micro and macro levels. Nine factors were identified:

- 1) *Economic inflation:* Inflation refers to the relationship between money and goods, where it occurs when the money supply increases against the goods (Downs Jr. 1980). Increases in real estate prices are generally in line with the inflation trend in other markets (Li *et al.* 2009). Property developers should be aware of this factor and its influence on the market (Nazer 2016).
- 2) *Economic deflation:* Deflation also refers to the relationship between money and goods, but it occurs when the quantity of the money supply declines in relation to the goods (Downs Jr. 1980). Deflation impacts the prices of many markets, including commodity and real estate markets, as the prices of these markets decrease during deflationary periods (Pederson 1999).
- 3) *Organizational budget:* The budget of a corporation trading in the real estate market is an indicator that can be used to measure the performance of CREM (Bon 1992). Assessing the budget of an organization is a basic task in the CREM, representing a determinant that describes the financial performance of the organization (Jordan *et al.* 2009). Several variables affect this factor, including the expenses of real estate projects and operations (Varcoe 2002).
- 4) *Revenues from real estate investments:* Revenue from CRE is among the key considerations used for the strategic planning of the CREM, as well as for measuring the performance of CREM (Jordan *et al.* 2009). In fact, one of the purposes of CRE is to increase the profits of a corporation from property investments (Kaluthanthri 2014).
- 5) *Volume of organizational loans:* Volume of loans taken by the organization for the acquisition or development of lands and built assets is one of the competitiveness factors that influence the real estate market (Li *et al.* 2009). The ease of access to loans can affect the investment as well as the performance of commercial real estate (Abel O. and Deborah O. 2016).
- 6) *Purchasing power of people:* Purchasing power of people is an important determinant to be explored in the profession of property management, due to its impact on the tone of the real estate market (Downs Jr. 1980). The purchasing power of people influences the performance of the real estate economy, in terms of its impact on the supply and demand trends (Rajwayi 2016). Many corporations consider this during the selection of a property location, due to its direct bearing on their customers' liquidity (Rymarzak and Sieminska 2012).
- 7) *Economic value of properties owned by the organization:* The market value of the properties is seen as a factor that influences the performance of real estate (Pittman and Parker 1989). It is an important factor that needs to be determined for all properties, so that the identification of whether a property is overpriced or not can be determined. It supports the decision-making of whether to sell or hold a property (Rajwayi 2016).
- 8) *Financial liquidity of the organization:* Liquidity of corporations is one of the main influences on their decision-making to move forward with investing in a project, service, or partnership (Kaksonen 2014). The decision of owning or leasing a real property is often based on the liquidity of the corporation, in which the maximization of the liquidity is considered a criterion for that decision (Hartmann *et al.* 2007). This factor varies from one situation to another, and it mostly constitutes a problem for small businesses (Graham *et al.* 2014).

- 9) *Prices of the energy market*: The real estate market is a market within a set of markets that impact the property market, and thus, property managers must be aware of and consider the impact of these markets (Downs Jr. 1980). The national economy is a mix of several markets, in which the real estate market is directly influenced by them (Liow and Angela 2017). Thus, the real estate market could grow in response to the development of other markets. For instance, the oil market has contributed to rapid urbanization and development in the Saudi real estate market during the 1970s (Opoku and Abdul-Muhmin 2010).

Factors related to the real estate market

These factors concern market dynamics and competition. Seven factors were identified:

- 1) *Occupancy (supply and demand) in the real estate market*: The occupancy of real estate is in line with the law of supply and demand dynamics, similar to what occurs in other commodity markets. The total number of units available is known as “supply”, while the number of tenants or buyers able to pay for these units is known as “demand” (Downs Jr. 1980). Both supply and demand are influenced by the economy, land availability, and other aspects (Rajwayi 2016).
- 2) *Ranges of real estate prices*: Rates of real estate prices are one of the factors that have a direct bearing on the real estate market, influenced by the occupancy (Downs Jr. 1980). The rental value influences property investments (Abel O. and Deborah O. 2016). Accordingly, understanding market prices is one of the basic functions of CREM (Edwards and Ellison 2009).
- 3) *Construction activities*: From a macroscale perspective, the volume of construction activities is considered one of the factors that affect the real estate market (Downs Jr. 1980). However, the rapid increase in construction is not always a positive indication, as it might indicate a huge amount of debt taken on by developers (Pederson 1999). From a corporate perspective, construction activities are one of the concerns of CREM and so costs and types of projects need to be taken into account (Elofsson and Lindstedt 2012).
- 4) *Amount of rents delinquent to be paid by tenants*: The dynamic of the real estate market is a cycle of prosperity and recession. The recession occurs in response to several factors, but when it occurs, delinquency of rental payments and vacancy levels increase (Downs Jr. 1980). This can also result in unpaid rents by tenants (Abel O. and Deborah O. 2016).
- 5) *Volume of filed suits in the court due to unpaid rents or deposits*: The number of eviction suits raised in local courts is one of the considerations that the property manager shall consider in their management plan (Downs Jr. 1980). In this regard, property and corporate managers shall also be aware of the legal applications and property rights (Edwards and Ellison 2009).
- 6) *Relationship status between users and the organization*: Understanding the users’ characteristics, including tenants, is one of the responsibilities that need to be comprehended for a strategic CREM (Edwards and Ellison 2009). A sound relationship needs to be maintained between the property manager and the tenant in order to avoid the occurrence of any problems and dissatisfaction between both parties (Downs Jr. 1980). This can help in providing a suitable built environment in a satisfactory manner, which can contribute to enhancing the value of the investment portfolio (Holfert and Villamide 2011; Halvitigala and Reed 2015).
- 7) *Innovations and advancements in other commodity markets*: Recall that the real estate market is a market within a set of other markets. Other markets, such as the telecommunications and commodity markets, are always developing sectors where their innovations can contribute to adding value to CRE (Musa and Baharum 2012; Holfert and Villamide 2011).

In summary, Figure 1 summarizes the above-defined factors from our literature study. These factors were used in the questionnaire to assess their significance in practice, from the perspective of practitioners.

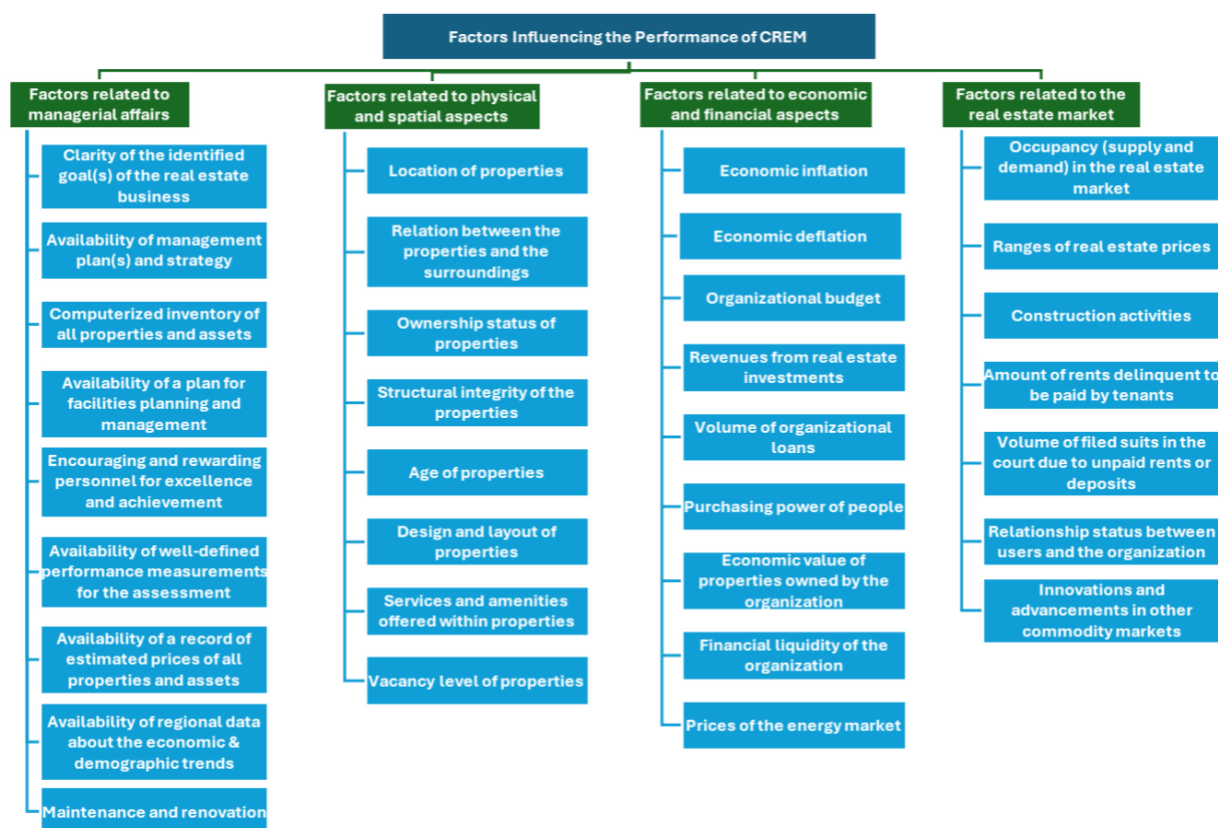


Figure 1 An overview of the identified factors influencing the performance of CREM. Source: Authors' own work

RESULTS

The questionnaire was distributed randomly among 35 practitioners of CREM in the Dammam Metropolitan Area. Due to an extensive follow-up, 33 samples were received and analyzed. Table 2 presents the profile of respondents.

Table 2 Profile of professionals involved in the survey

Category	Frequency	Percentage
Respondent position		
Property manager	6	18.2%
Chief executive officer (CEO)	1	3.0%
Facilities manager	10	30.3%
Financial manager	2	6.1%
Cost control engineer	0	0.0%
Other	14	42.4%
Total	33	100%
Years of experience		
Less than 5 years	4	12.1%
5 to 10 years	11	33.3%
10 to 20 years	15	45.5%
Over 20 years	3	9.1%
Total	33	100%
Types of projects practiced by respondents (multiple answers)		
Apartment Buildings	27	81.8%
Single Houses (Villas)	26	78.8%
Shops	20	60.6%
Office Buildings	21	63.6%
Commercial Centers/ Malls	5	15.2%
Other	6	18.2%

Table 3 illustrates the overall responses to the factors' assessment. Overall, the calculation of the average of RII values indicates that all categories are 'Very Important', confirming the significance of the four groups of factors and their direct impact on CREM performance.

Table 3 Overall responses to the assessment of the factors influencing the performance of CREM

Factors Influencing the Performance of Corporate Real Estate Management	Importance Level						Total	RII (%)	Rank	Importance rate
	Extremely Important	Very Important	Important	Somewhat Important	Not Important					
Factors related to managerial affairs								80.2%	1	VI
Clarity of the identified goal(s) of the real estate business	17	11	5	0	0	33	84.1%	4	VI	
Availability of management plan(s) and strategy of the business	19	14	0	0	0	33	89.4%	1	EI	
Computerized inventory of all properties and assets	15	12	4	1	1	33	79.5%	8	VI	
Availability of a plan for facilities planning and management	18	12	3	0	0	33	86.4%	3	VI	
Encouraging and rewarding personnel for excellence and achievement	14	15	4	0	0	33	82.6%	5	VI	
Availability of well-defined performance measurements used for the assessment of the real estate business	13	15	5	0	0	33	81.1%	6	VI	
Availability of a record of estimated prices of all properties and assets	9	13	9	2	0	33	72.0%	13	VI	
Availability of regional data and statistics about the economic and demographic trends	7	10	12	3	1	33	64.4%	18	VI	
Maintenance and renovation	17	10	5	1	0	33	82.6%	5	VI	
Factors related to physical and spatial aspects								77.2%	2	VI
Location of properties	16	14	2	1	0	33	84.1%	4	VI	
Relation between the properties and the surroundings	11	13	7	2	0	33	75.0%	10	VI	
Ownership status of properties	10	10	8	3	2	33	67.4%	16	VI	
Structural integrity of the properties	21	8	4	0	0	33	87.9%	2	EI	
Age of properties	10	12	10	1	0	33	73.5%	12	VI	
Design and layout of properties	18	6	6	3	0	33	79.5%	8	VI	
Services and amenities offered within properties	16	11	4	2	0	33	81.1%	6	VI	
Vacancy level of properties	10	10	8	5	0	33	68.9%	15	VI	
Factors related to economic and financial aspects								72.9%	3	VI
Economic inflation	12	13	6	2	0	33	76.5%	9	VI	
Economic deflation	12	11	7	3	0	33	74.2%	11	VI	
Organizational budget	9	15	7	2	0	33	73.5%	12	VI	
Revenues from real estate investments	12	18	1	2	0	33	80.3%	7	VI	
Volume of organizational loans	8	11	9	4	1	33	65.9%	17	VI	
Purchasing power of people	17	9	7	0	0	33	82.6%	5	VI	
Economic value of properties owned by the organization	8	12	9	3	1	33	67.4%	16	VI	
Financial liquidity of the organization	15	11	6	0	1	33	79.5%	8	VI	
Prices of the energy market	5	6	16	4	2	33	56.1%	20	I	
Factors related to the Real Estate Market								70.5%	4	VI
Occupancy (supply and demand) in the real estate market	19	11	2	1	0	33	86.4%	3	VI	
Ranges of real estate prices	9	18	5	1	0	33	76.5%	9	VI	
Construction activities	4	18	8	3	0	33	67.4%	16	VI	
Amount of rents delinquent to be paid by tenants	9	15	6	1	2	33	71.2%	14	VI	
Volume of filed suits in the court due to unpaid rents or deposits	10	6	11	3	3	33	62.9%	19	VI	
Relationship status between users and the organization	14	9	7	1	2	33	74.2%	11	VI	
Innovations and advancements in other commodity markets	5	8	11	6	3	33	54.5%	21	I	

Factors related to managerial affairs

Under this category, “availability of management plan(s) and strategy of the business,” is the most important factor influencing CREM. It received an importance rate of ‘Extremely Important’, with the

first rank among all factors. However, the other eight factors received an importance level of 'Very Impartment'. The second two important factors in this category are the availability of a plan for facilities planning and management, and clarity of the identified goal(s) of the real estate business.

Factors related to physical and spatial aspects

The results show that "structural integrity of the properties" is the most significant factor influencing CREM. It received an importance rate of 'Extremely Important', with the first rank among all factors. The other seven factors received an importance level of 'Very Impartment'. The second two important factors in this category are "location of properties" and "services and amenities offered within properties", respectively.

Factors related to economic and financial aspects

Under this category, eight factors received an importance rate of 'Very Important', namely "economic inflation", "economic deflation", "organizational budget", "revenues from real estate investments", "volume of organizational loans", "purchasing power of people", "economic value of properties owned by the organization", and "financial liquidity of the organization". One factor, "prices of the energy market," received an importance rate of "Important". Based on the RII of the eight very important factors, "purchasing power of people", "revenues from real estate investments", and "financial liquidity of the organization" are the most influential economic factors on CREM performance.

Factors related to the real estate market

Under this category, only one factor received an importance rate of 'Important', "innovations and advancements in other commodity markets". The other six factors received an importance rate of 'Very Important'. Out of these factors, "occupancy (supply and demand) of the real estate market", "ranges of real estate prices", and "relationship status between users and the organization" are the most influential market-related factors on the CREM performance

DISCUSSION AND CONCLUSION

CREM deals with the management of organizational properties. Several factors influence the performance of CREM. This paper focuses on the definition and assessment of these factors.

The methodology followed in this paper is twofold. First, a literature review was conducted to identify the factors inductively. Second, a 5-point Likert scale questionnaire was conducted to deductively assess the significance of the identified factors, using the RII as an indicator.

Thirty-three factors were identified and classified under four categories, namely: (1) managerial affairs, (2) physical and spatial aspects, (3) economic and financial aspects, and (4) real estate market. The results pointed out that these groups have been rated "very important, confirming their importance and influence in practice. Regarding the factors' assessment, the findings indicate that the availability of management plan(s) and strategy of the business, availability of a plan for facilities planning and management, the structural integrity of the properties, and the occupancy indicators have been perceived as the most influential factors on the CREM performance. Accordingly, this study calls scholars and practitioners to adopt and incorporate a multidimensional paradigm into the CREM practices to contribute to enhancing its performance.

Reflecting on the responses, the observations from this study are context-specific, limited to a geographical area – Damman Metropolitan Area. Yet, these observations are relevant to other contexts, as the respondents to the questionnaire are practitioners who have been involved in CREM. Thus, the results of this paper are not generalizable; they ultimately set the stage for future research and practice by virtue of bringing together theoretical insights from the literature and empirical observations from practice.

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Exploring FM Practices in Urban Transformation Areas Towards Effective Management Models: Four Case Studies in Türkiye

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ABSTRACT

Background and Aim. Facility management (FM) in urban transformation areas is underexplored globally and still emerging in Türkiye. This study examines FM practices in selected cases, identifies key challenges, and evaluates user satisfaction and potential management models through participatory fieldwork, thereby addressing a notable gap in the literature.

Methods and Data. A survey of 1,254 residents in four urban transformation zones assessed satisfaction with FM services and identified related issues. Data were analysed using statistical methods, mainly chi-square tests, to capture diverse household experiences and ensure representativeness across the study areas.

Results. The study uses a participatory fieldwork approach to inform policy and increase awareness of FM in urban transformation areas. Results show regional variation: while 96.9% of participants prefer professional management, areas with higher ownership rates favour condominium-based models. Significant issues, such as understaffing (33.3%), poor maintenance (29.1%), and communication problems (20.8%), demonstrate that regional dynamics strongly influence management preferences and satisfaction.

Originality. This study examines how user satisfaction, sustainability, and the preservation of economic value relate to management models in urban transformation areas. In the context of Türkiye's growing transformation needs and the early development of FM, it offers a fresh contribution to the literature.

Practical and Societal Implications. Developing an effective management model in urban transformation areas is expected to enhance resident satisfaction and mitigate management-related issues. The findings may also apply to other cases, providing a transferable framework for enhancing Facility Management practices.

Type of Paper. Full Research

KEYWORDS. built environment management, facility management, facility services, satisfaction ratios, urban transformation

INTRODUCTION

Today, complex challenges such as rapid population growth, physical deterioration of buildings, disaster risk, and spatial dysfunctionality have placed urban transformation initiatives at the forefront of urban policy agendas (Genç, 2008). In Türkiye, migration from rural settlements to urban areas following the 1950s has resulted in the development of slum regions in proximity to urban centres, thereby transforming such unhealthy and unplanned settlements by the 2000s (Keskin et al., 2023). The high susceptibility of housing and other structures built before 2000 to earthquakes and disasters has further underscored the need for transformation policies. In response, Law No. 6306 (2012) concerning the Transformation of Areas at Disaster Risk, along with related municipal regulations, has expedited the process (Tanrıvermiş et al., 2017; Özdemir et al., 2023).

Nevertheless, urban transformation extends beyond the renewal of physical structures; it also requires a comprehensive approach that incorporates social, economic, and administrative aspects (Eraydın & Tasan-Kok, 2013). In addition to enhancing spatial quality and resilience, the development of sustainable living environments necessitates the implementation of effective and inclusive management mechanisms (Keskin, 2023). The emerging urban environments post-transformation not only reshape the built environment but also influence social relations, property frameworks, and collective living practices, thereby giving rise to complex governance challenges (Ay & Penpecioglu, 2022). Within this context, the success of urban transformation initiatives hinges not only on the quality of physical renewal but also on the efficacy of governance models capable of ensuring sustainable facility and property management. This study addresses this managerial dimension directly by analysing facilities management practices in four large-scale urban transformation projects in Ankara.

The remainder of the study is organised as follows: the immediate subsection presents the literature review findings, followed by the background of the study, method and data, results, discussion, and finally, the conclusion.

LITERATURE REVIEW

The processes of urban transformation and urban renewal have been extensively examined within the international scholarly literature since the 1990s. Prior research has investigated topics including spatial planning (Eraydın & Tasan-Kok, 2014), social justice and displacement (Benneworth, 2016; McCarthy, 2010; Mini, 2016; Xian & Gu, 2020), economic implications (Brzica, 2023; Mikelsone et al., 2021), disaster risk mitigation (Çaki & Uzun, 2023; Dhyani et al., 2018), and legal frameworks (Elicin, 2014; Mattei & Quarta, 2015; Taktak & Temiz, 2017). In Türkiye, subsequent scholarship following Law No. 6306 has predominantly concentrated on the modernisation of housing stock in relation to disaster risk and the socio-economic consequences of urban transformation.

Despite the extensive body of research in this field, the management of post-transformation areas remains insufficiently explored. Critical issues such as the organisation of facility management (FM), the sustainability of common areas, governance mechanisms, and resident satisfaction are either superficially addressed or neglected entirely (Chiu et al., 2019; Diamond et al., 2010; Mutale & Edwards, 2002). International studies similarly highlight governance deficiencies in large-scale regeneration projects (Taşan-Kok, 2012). The success of urban transformation initiatives appears to be closely tied to the quality of physical alterations and the effectiveness of the governance model implemented within these areas. The development of sustainable urban environments is feasible with the establishment of transparent and accountable governance structures that emphasise the participation of local stakeholders (Healey, 1997). In Türkiye, practical challenges—including limited institutional capacity, restricted stakeholder engagement, and inadequate professional facility management—are frequently encountered (Keskin & Tanrıvermiş, 2025). However, these issues have yet to be systematically conceptualised within academic discourse. This presents a distinct research gap: the lack of comprehensive empirical studies focusing on facility and property management in post-transformation areas, and their influence on governance, resident satisfaction, and long-term sustainability. Through a large-scale household survey involving 1,254 participants across four major urban transformation projects in Ankara, this research seeks to address this gap. It offers empirical insights into the interplay between user satisfaction, management modalities, and governance practices, whilst proposing context-specific models to enhance institutional capacity and regulatory frameworks.

BACKGROUND

Urban transformation has become a central urban policy tool in Türkiye due to rapid population growth, the seismic vulnerability of pre-2000 housing stock, and the need to replace unplanned and unsafe settlements. Beyond physical renewal, these processes introduce new social and managerial challenges that require sustainable governance mechanisms. In this context, Facility Management

(FM) is critical for addressing collective living, maintenance of shared areas, user satisfaction, and stakeholder coordination. However, FM practices in urban transformation zones remain underdeveloped in Türkiye, highlighting the need for comprehensive analysis. Türkiye's built environment continues to expand, driven by rising welfare levels and demand for residential and commercial spaces. As of 2024, the country has 9.8 million buildings and 28.3 million dwellings, with residential uses comprising over 81% of total structures. Urban transformation areas, in particular, show significant vertical growth, increasing the need for effective management of multi-storey buildings. Although 600–650 thousand new dwellings are built annually, the renewal rate of the existing stock remains low at 2.33%, raising concerns about the safety of older structures-57% of which predate 2000. Persistent declines in household size and homeownership, alongside a steady rise in the number of households and dwellings, further reshape housing demand and management needs. Given ongoing debates around post-construction service quality, particularly in mass housing and slum-renewal projects, it is essential to investigate FM practices in major urban regeneration areas. This study, therefore, focuses on four large-scale transformation zones in Ankara, aiming to identify existing management models, assess service adequacy, and evaluate whether user expectations are met during the post-construction phase.

METHODS AND DATA

Data collection

This study examines the management challenges that arise following urban transformation, based on extensive field research conducted across four distinct urban transformation zones within Ankara Province. The research utilises data from the project titled “Analysis of Post-Transformation Built Environment Management Models in Urban Transformation Project Implementation Areas: Urban Transformation Projects in Ankara” (Tanrıvermiş et al., 2023). The designated project zones encompass the North Ankara Urban Transformation Project in Keçiören and Altındağ districts, the Dikmen Valley Urban Transformation Project in Çankaya district, the Güneykent (İlkbahar Neighbourhood) Urban Transformation Project in Çankaya district, and the Mamak Urban Transformation Project in Mamak district.

The primary objective of the field study is to evaluate the levels of administrative satisfaction, identify problems, and ascertain the expectations of households residing in these regions. Additionally, the study aims to analyse facility management (FM) practices, governance models, and structural challenges that influence these outcomes. A comprehensive household survey was selected as the primary methodology, as it facilitates not only the assessment of satisfaction levels, issues, and expectations but also enables the examination of the relationship between user satisfaction and the implemented FM models. Demographic and socioeconomic variables were incorporated, given their direct influence on management preferences and perceptions of service quality. Statistical techniques, such as Chi-square tests and logistic regression, were employed to identify significant associations and determinants of satisfaction, thereby ensuring that the analysis extends beyond mere descriptive findings to uncover the structural factors affecting FM outcomes. The sample size was determined using the classical sampling formula (Çingir, 2009), with a 95% confidence level and a 3% margin of error, resulting in a calculated sample of 1,030 households from a total population of 28,322. Nevertheless, owing to accessibility issues and substitution practices, a total of 1,254 households were ultimately surveyed. The distribution of the sample was conducted employing a weighted approach based on the number of households within each area (Çingir, 2009).

The data were collected utilising a structured, face-to-face questionnaire administered by trained researchers. The questionnaire was specifically designed for this investigation, drawing on existing literature and expert consultations, and was piloted prior to its field deployment. It encompassed multiple dimensions, including demographic characteristics, household composition, educational attainment, income levels, housing features, ownership status, rental and fee expenditures, perceptions regarding housing investment, satisfaction with FM, issues related to block or site

management, and the management of common areas. Participation in the survey was voluntary; in instances of refusal, alternative households were systematically sampled and interviewed.

Data Analysis Technique

Following the fieldwork, the research team engaged in coding and data entry, accompanied by integrity and consistency assessments to ensure the quality of the data. The data were then analysed using SPSS 20 (Statistical Package for the Social Sciences). Initially, frequency and percentage distributions were presented, followed by cross-tabulations and Chi-Square tests to identify potential relationships between variables. Logistic regression analysis was conducted to determine the main factors influencing managerial satisfaction, with a significance level set at 0.05. A p-value less than 0.05 was considered statistically significant.

RESULTS

The structural trends in housing production and renewal (Table 1) underscore the necessity for comprehensive empirical research concerning the organisation and perception of FM within urban transformation zones. To enhance clarity and systematic presentation of the findings, the Results section has been subdivided into three distinct subsections: (1) Demographic Data, (2) Applied FM Management Models, and (3) Management Challenges and Potential Solutions.

Demographic Data. To understand the variations in satisfaction and management models across urban transformation zones, it is essential first to present the demographic and socioeconomic profiles of the respondents. These characteristics establish the foundation for interpreting subsequent findings. They provide context for understanding differences in satisfaction levels and preferences for management models within the case areas. To analyse the relationship between consumer or user satisfaction and management frameworks in urban transformation zones, the objective was to collect opinions and suggestions from users and owners through both multiple-choice and open-ended questions during field studies. This approach aimed to identify existing issues, explore potential solutions, and develop a strategic roadmap for policy formulation targeting key problem areas. In this regard, a total of 1254 questionnaires were distributed. An examination of respondents' gender distribution indicates that 53.2% of participants in the North Ankara region, 51.2% in Dikmen, and 53.1% in Mamak are female. Conversely, 70.3% of respondents in Güneykent are male (Table 1).

Table 1 Gender groups of the participants

Gender	North Ankara		Dikmen		Mamak		Güneykent		Total	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Woman	243	53.2	104	51.2	113	53.1	113	29.7	573	45.7
Man	214	46.8	99	48.8	100	46.9	268	70.3	681	54.3
Total	457	100.0	203	100.0	213	100.0	381	100.0	1254	100.0

An analysis of the educational levels of the respondents reveals that 55.6% of participants from the North Ankara region, 65.5% from the Dikmen region, 25.4% from the Mamak region, and 67.6% from the Güneykent region hold university degrees (see Table 2). The elevated educational attainment may be attributed to the considerable number of individuals involved in real estate transactions—including selling, buying, and renting—in the project area subsequent to the transformation. Additionally, it may reflect the willingness of highly educated individuals to participate in surveys.

Table 2 Educational status of the participants

Education Status	North Ankara		Dikmen		Mamak		Güneykent		Total	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio(%)

Primary education and below	63	13.8	4	2.0	94	44.1	10	2.7	171	13.7
High school	103	22.5	52	25.6	33	15.5	41	10.8	229	18.3
University	254	55.6	133	65.5	54	25.4	257	67.6	698	55.7
Graduate	37	8.1	14	6.9	32	15.0	72	18.9	155	12.4
Total	457	100.0	203	100.0	213	100.0	381	100.0	1254	100.0

Although 74.8% of respondents in North Ankara are property owners, this proportion decreases to 53.2% in Dikmen, 57.3% in Mamak, and markedly declines to a minimal level of 8.1% in Güneykent. Conversely, the rental rate stands at 25.2% in North Ankara and increases to 91.9% in Güneykent, demonstrating a significant regional disparity (Table 3).

Table 3 Ownership status of the participants

Real Estate Ownership	North Ankara		Dikmen		Mamak		Güneykent		Total	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Real Estate Owner	342	74.8	108	53.2	122	57.3	31	8.1	603	48.1
Tenant	115	25.2	95	46.8	91	42.7	350	91.9	651	51.9
Total	457	100.0	203	100.0	213	100.0	381	100.0	1254	100.0

Applied FM management models

Following the presentation of the demographic context, this subsection analyses the Facility Management (FM) models applied in various project areas and the factors influencing management preferences. These findings directly address the study's objective of investigating governance mechanisms within post-transformation contexts. The results indicate that the management structures of residential units within urban transformation zones are predominantly evaluated at the regional level. While 40.8% of respondents reported engaging services from professional FM companies, this proportion increases to 81.1% in Güneykent, signifying a notable disparity compared to other regions. Conversely, in districts such as North Ankara and Mamak, management boards composed of condominium owners are more prevalent (22.1% and 100%, respectively). The greater prevalence of professional management firms in Güneykent appears to correlate with the area's socio-economic profile and the management preferences of property owners. Given the benefits associated with collaboration with professional firms—such as enhanced efficiency, expertise, and standardisation—it can be inferred that this management model is favoured, particularly in large-scale residential developments. Nevertheless, it remains evident that models involving direct management by condominium owners continue to exist, especially in regions characterised by strong local dynamics. Consequently, the distribution of management models is influenced by regional socio-economic factors and the diverse perspectives of property owners (Table 4).

When FM companies engaged in urban transformation areas, concerted efforts were undertaken to identify regional disparities in the timing of their involvement. The data demonstrate that the timing of professional engagement in management processes exhibits considerable variation across regions. Notably, in Güneykent, 70% of FM companies participated during the licensing stage. Conversely, 57.4% of respondents in North Ankara indicated that they “do not know” the commencement of the management company's activities, pointing to a significant lack of transparency in the process. Furthermore, only 3.4% of management companies were involved during the project design phase, and an even smaller percentage, 0.8%, during the construction phase. These findings suggest that FM is frequently regarded as an afterthought rather than being incorporated into the urban transformation process from the beginning (Table 5).

Table 4 Features of building/site management

	North Ankara		Dikmen		Mamak		Güneykent		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Management Style										
Professional FM company	201	44.0	2	1.0	0	0.0	309	81.1	512	40.8
The board of directors, established by condominium owners	101	22.1	184	90.6	213	100.0	41	10.8	539	43.0
Management co-operative established by condominium owners	6	1.3	8	3.9	0	0.0	0	0.0	14	1.1
Procurement of services from lawyers, financial advisors and other professionals	3	0.7	0	0.0	0	0.0	0	0.0	3	0.2
Temporary construction management	73	16.0	1	0.5	0	0.0	0	0.0	74	5.9
Lack of knowledge about management	73	16.0	8	3.9	0	0.0	31	8.1	112	8.9
Total	457	100.0	203	100.0	213	100.0	381	100.0	1254	100.0

Table 5 Periods of starting to work with the FM company if the management is carried out by procuring services from the FM company

Time to start working with an FM company	North Ankara		Dikmen		Mamak		Güneykent		Total	
	Number	Ratio (%)	Number	Ratio(%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
During the project phase	18	4.5	0	0.0	0	0.0	21	6.7	39	3.4
During the construction phase	9	2.2	0	0.0	0	0.0	0	0.0	9	0.8
During the licensing phase	0	0.0	0	0.0	0	0.0	216	70.0	216	19.0
After the licence is obtained	34	8.5	180	89.1	0	0.0	41	13.3	255	22.4
After the residency starts	110	27.4	0	0.0	42	18.5	21	6.7	173	15.2
Temporary construction management	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
I have no information about the management	230	57.4	22	10.9	185	81.5	10	3.3	447	39.2
Total	401	100.0	202	100.0	227	100.0	309	100.0	1139	100.0

Management Problems and Possible Solutions

Finally, the analysis addresses the primary management challenges faced by residents and explores potential solutions. This section correlates the findings related to satisfaction, challenges, and service quality with the broader inquiry into developing sustainable management models within urban transformation zones. The study examined the issues encountered by residents in four urban transformation areas related to Facility Management (FM). The results indicate prevalent managerial

shortcomings: 33.3% cited insufficient personnel, 29.1% reported inadequate maintenance and irregularity, 20.8% experienced communication difficulties with management, 6.2% noted poor cleaning services, and 4.9% reported untimely garbage collection. Structural concerns such as security (3.7%) and parking shortages (2.0%) were less frequently observed. Overall, the findings underscore the necessity of not only physical modifications but also the professional planning and implementation of Facility Management (FM). (Table 6)

Table 6 Main management problems

Main Problems	Total	
	Number	Ratio (%)
Inadequate number of personnel	417	33.3
Poor maintenance and irregularity of the built environment	365	29.1
Inaccessibility to the management	261	20.8
Inadequate cleanliness	78	6.2
Solid wastes are not collected on time	61	4.9
Security problems	47	3.7
Lack of car parking	25	2.0
Total	1254	100.0

The chi-square test revealed a statistically significant relationship between the location variable and perceptions of the effectiveness of building or site management ($\chi^2 = 634.696$; $p = 0.0001$). In particular, the Güneykent Project area shows a higher perception that management is 'very effective', while in North Ankara, the dominant view is that of 'poor effectiveness'. This indicates that satisfaction with site management varies by region and that local conditions might influence perceptions of management (Table 7).

Table 7 Response to 'How would you evaluate the effectiveness of building/site management?'

Management Effectiveness	North Ankara		Dikmen		Mamak		Güneykent		Total		Chi-Square Analysis	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Chi-Square	p
Very effective	9	2.0	4	2.0	5	2.3	175	45.9	193	15.4	634.696	0.0001
Effective	109	23.9	94	46.3	144	67.6	134	35.1	481	38.3		
No opinion	109	23.9	77	37.9	35	16.4	41	10.8	262	20.9		
Weakly effective	197	43.1	22	10.8	28	13.1	31	8.1	278	22.2		
Not effective at all	33	7.2	6	3.0	1	0.5	0	0.0	40	3.2		
Total	457	100.0	203	100.0	213	100.0	381	100.0	1254	100.0		

The distribution of responses to the question 'From whom should service procurement be made?' across different locations is presented in Table 9. The data indicates that the most favoured option for service procurement is a "Professional FM company," chosen by 96.9% of respondents. This preference is particularly evident in the North Ankara, Mamak, and Güneykent regions, where 100% of participants endorse this choice. In the Dikmen region, the percentage is slightly lower at 85.9%, indicating the presence of alternative options to some extent. Specifically, in Dikmen, 6.5% of respondents preferred a "Security company," while "Cleaning company" and "Construction company"

were selected by 3.2% and 2.2% of respondents, respectively. The “Other” category was also only chosen in Dikmen, at a rate of 2.2%. These findings illustrate a broad consensus supporting the delegation of management services to professional companies in most regions, with Dikmen exhibiting more diverse preferences. This variation may be ascribed to regional needs, demographic characteristics, or prior experiences with service delivery (Table 8).

Table 8 Response to ‘From whom should services be procured?’

Service Procurement	North Ankara		Dikmen		Mamak		Güneykent		Total	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Professional FM company	400	100.0	238	85.9	227	100.0	341	100,0	1206	96.9
Security company	0	0.0	18	6.5	0	0.0	0	0.0	18	1.4
Cleaning company	0	0.0	9	3.2	0	0.0	0	0.0	9	0.7
Construction company	0	0.0	6	2.2	0	0.0	0	0.0	6	0.5
Other	0	0.0	6	2.2	0	0.0	0	0.0	6	0.5
Total	400	100.0	277	100.0	227	100.0	341	100.0	1245	100.0

DISCUSSION

The findings of this study provide compelling evidence that regional and socio-economic structures significantly shape Facility Management (FM) practices in urban transformation areas. The strong association between the high prevalence of tenants and the preference for professional management companies in Güneykent demonstrates that user profiles directly influence management choices. This supports Healey’s (1997) emphasis on stakeholder participation, yet our results refine this view by showing that where ownership is limited, residents favour standardised professional services over participatory models. Conversely, in regions with higher ownership levels, such as North Ankara and Mamak, condominium owners’ participatory boards are more common. While this reflects the importance of local participation (Taşan-Kok, 2012), the lower perceived managerial effectiveness in these areas highlights the weaknesses of such models without institutional support. This differs from Chiu et al. (2019), who found that culture-led participation in Taipei generated successful regeneration outcomes; in Türkiye, participation without institutionalisation appears insufficient. Moreover, our findings align with Diamond et al. (2010) and Mutale & Edwards (2002), confirming that participatory structures alone do not guarantee managerial success.

A further contribution of the study is the identification of structural problems, such as understaffing (33.3%) and inadequate maintenance (29.1%), that persist across all regions. These issues extend the international debate, where managerial sustainability is often overshadowed by legal or economic concerns (Elicin, 2014; Mikelson et al., 2021). Unlike macro-level approaches, our empirical evidence shows that operational deficiencies at the micro level undermine the long-term sustainability of FM systems. The very high preference for professional management companies (96.9%) indicates that households view specialised, centralised services as more reliable than fragmented, participatory arrangements. However, variations in places such as Dikmen reveal that socio-economic conditions continue to influence management preferences. This confirms that uniform governance strategies are untenable and reinforces calls in the literature for context-sensitive approaches, while providing new insights from the Turkish setting.

Overall, the study directly addresses the research gap concerning the lack of empirical evidence on post-transformation management practices and their effects on user satisfaction. It advances the literature by confirming established arguments (Healey, 1997; Taşan-Kok, 2012), contextualising others (Chiu et al., 2019), and adding empirical depth on how governance shapes satisfaction, managerial effectiveness, and practical challenges in post-transformation FM.

CONCLUSIONS

This study analyses the FM models employed in four urban transformation areas in Ankara and highlights how management structures relate to socioeconomic factors. The results reveal apparent regional differences. In Güneykent, where tenant density is high, the preference for professional FM companies is markedly stronger. By contrast, in areas such as North Ankara and Mamak, where property ownership is widespread, management models that involve direct participation by condominium owners are more common. A key finding concerns the relationship between the timing of management company involvement and overall effectiveness. Early engagement at the licensing stage in Güneykent (70%) and the corresponding high satisfaction levels demonstrate the value of early intervention. Conversely, delayed involvement and limited transparency in North Ankara have led to weaker perceptions of effectiveness, underscoring the need to integrate FM into urban transformation processes from the outset.

The effectiveness of management models varies substantially across regions. In Güneykent, 45.9% of residents rate professional management as “very effective,” reflecting the benefits of standardised service delivery. Nonetheless, issues such as understaffing (33.3%) and inadequate maintenance (29.1%) show that even professional models face operational challenges. Communication difficulties (20.8%) and low satisfaction in owner-managed buildings indicate that participatory models require stronger institutional support. In line with these findings, management approaches should be tailored to regional conditions: professional companies should be encouraged in areas with high tenant density, while capacity-building mechanisms are needed for condominium owners in regions dominated by property ownership. Strengthening legal frameworks, enhancing transparency, and expanding digital management platforms would further address communication and performance-related issues.

This study is limited to four transformation projects in Ankara, which may constrain generalisability. The limited qualitative depth of survey data and the time-bound nature of the dataset also restrict the ability to explore underlying causes and long-term dynamics. Nevertheless, the large sample of 1,254 households and systematic sampling enhance the robustness of the findings. Future research should apply similar methods in different cities, employ qualitative approaches to explore root causes of management problems, and conduct longitudinal studies to assess governance performance over time. Additionally, empirical assessment of digital management platforms would offer insights into the impact of technological integration.

Beyond its practical implications, the study makes a substantive contribution to the literature. While previous research on urban transformation has centred on legal, planning, or socio-economic dimensions, managerial processes- particularly the link between post-transformation governance and facility management- have received limited scholarly attention. By empirically demonstrating the interplay between governance structures, user satisfaction, and management models, this study addresses this gap and provides a foundation for future work on sustainable facility management.

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Post-pandemic Office Market in the Ankara Province of Türkiye

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ABSTRACT

Background and Aim. The COVID-19 pandemic marked a period of some of the most substantial transformations in office use in recent years. This study aims to describe the post-pandemic office market in Ankara Province, Türkiye. More specifically, the study analyses pandemic-induced changes in spatial deployment, identifies emerging spatial requirements, and assesses these factors from the perspectives of office employees and facility managers.

Methods and Data. A comprehensive survey was carried out in the key commercial centres of Ankara, including Kızılay, Ulus, Mustafa Kemal Neighbourhood, and Çukurambar Neighbourhood, which serve as central business districts. Responses were obtained from more than 1,000 participants. The collected data were analysed using quantitative methodologies to evaluate changes in spatial utilisation patterns during and after the COVID-19 pandemic.

Results. In line with the effects of the COVID-19 Pandemic, the findings indicate that spatial changes in office use have been identified. This study revealed that projects involving social facilities, security, technical infrastructure, and green building practices are likely to be proposed for Ankara in the future.

Originality. This research offers a significant perspective on the evolution of the office market during and following the COVID-19 pandemic. Its primary strength resides in its large sample size, which encompasses a broad spectrum of viewpoints and expectations. We assert that this distinction sets our study apart from existing scholarly work.

Practical and Societal Implications. By identifying key parameters that influence office space utilisation in Ankara Province, our study provides essential insights for designing and developing new offices, renovating existing ones, and ensuring user expectations are met in future developments.

Type of Paper. Technical

KEYWORDS. COVID-19, office buildings, office design, office management, project development

INTRODUCTION

The COVID-19 pandemic marked a period of some of the most substantial transformations in office use in recent years. The way workspaces were used evolved during this period; curfews and the risk of disease transmission accelerated the adoption of remote working arrangements. Technological developments in digitalisation, such as video calls and video-conferencing applications, alongside improved file transfer capabilities, were instrumental in this transformation. Concurrently, the proliferation of remote work opportunities led to a reduction or cessation of physical office use. Studies conducted by Alter (2020), Roberts (2020), Megahed and Ghoneim (2020), and Honey-Rosés et al. (2020) affirm that the emergence of these changes in the work environment during the pandemic was inevitable.

The pandemic hastened the move from traditional office setups to flexible, open-plan spaces that encourage face-to-face interaction, remote work, and environments with natural features and good ventilation. These new spatial arrangements are driven by post-pandemic work habits, with ongoing

development of these innovative formats (Alter, 2020; Muggah and Ermacora, 2020). Observations indicate that measures such as increased individualisation of office spaces, greater digitalisation, and remote work adoption are direct pandemic outcomes, which are expected to persist. Meanwhile, mobile devices like laptops, tablets, and smartphones, along with widespread internet access, enable individuals to create their own productive work environments anywhere (Sevimli, 2021; Demirkaya, 2024). Nonetheless, this does not mean physical offices will completely disappear. Changes have mainly involved reducing or expanding space use or shifting location. In this context, Tanrıvermiş's (2020) study suggests the COVID-19 pandemic might negatively impact office investments in Turkey's real estate sector, prompting quick adaptations in workspaces.

Office building space requirements depend on utilisation patterns, construction technologies, and management strategies, especially for communal areas (Weston, 2004; Lamb and Kwok, 2016; Honey-Roses et al., 2020). Facility management involves space-dependent services like maintenance, energy management, security, reception, social events, and rental administration. Effective layout employs rational design principles to enable efficient management, considering changing needs, environmental factors, technological advances, and operational decisions. Standardising services ensures consistent user satisfaction by ensuring designs comply with standards such as ISO 41001, ISO 41013, ISO 41014, and ISO 41018, especially in facility management. Operational factors must be integrated early in the design process, including location, building size, transportation, and user numbers.

Due to their continuous and diverse utilisation, the development and transformation of office spaces are primarily driven by the pursuit of the most convenient and comfortable working conditions. The correlation between comfort and productivity in the work environment has a substantial impact on employee retention and overall productivity, especially among satisfied workspace users. Achieving workplace comfort, while dependent on numerous factors, is predominantly influenced by design choices such as spatial dimensions, modes of utilisation, and spatial organisation. Additionally, trends in work styles, the location and accessibility of office buildings, construction technologies, and management models all play crucial roles in impacting employee satisfaction.

The transformation and modification of space occur in response to needs and influences, with societal events and technological advancements playing a proactive role. Consequently, spaces subject to continuous transformation and change can be adapted for office projects over different periods and diversified for various purposes (Megahed and Ghoneim, 2020; Muggah and Ermacora, 2020). Therefore, this study assesses the development and changes in the office markets of Ankara Province and the management models of office buildings, based on field study results.

This study aims to describe post-COVID-19 changes in office markets, investor and user preferences, satisfaction levels, and potential interrelations with the office management model. More specifically, the study analyses pandemic-induced changes in spatial deployment, identifies emerging spatial requirements, and assesses these factors from the perspectives of office employees and facility managers. A comprehensive survey was carried out in the key commercial centres of Ankara, including Kızılay, Ulus, Mustafa Kemal Neighbourhood, and Çukurambar Neighbourhood, which serve as central business districts. Responses were obtained from more than 1,000 participants. The collected data were analysed using quantitative methodologies to evaluate changes in spatial utilisation patterns during and after the COVID-19 pandemic.

The remainder of this paper comprises 5 sections and is structured as follows: Section 2 provides the theoretical background, focusing on the theory applied in this study. Section 3 presents the methods and data, explaining the data used in this study, followed by Section 4, which illustrates the results. Sections 5 and 6 are the discussion and conclusions, respectively.

THEORETICAL BACKGROUND

The theoretical foundation of this study is based on indoor environmental quality (IEQ). Felgueiras et al. (2024) and Dam-Krogh et al. (2025) reported that working adults spend a significant portion of their day in the office, making it essential to provide suitable IEQ to promote decent work for all. IEQ focuses on office design that prioritises workers' comfort. The rationale behind IEQ is that a comfortably healthy staff tends to perform better and reduce workplace stress. IEQ in offices is crucial for staff health and productivity. The four main components of IEQ are thermal, air, lighting, and sound environments (Li et al., 2021). It can be argued that, even if IEQ had not been a primary focus before the COVID-19 pandemic, the pandemic's embedded flexibility in spatial use has made the design of more comfortable office environments essential to attract users. Multiple studies support this assertion. Pilehchi et al. (2026) argued that Indoor Environmental Quality (IEQ) is a concept that links human health and comfort, and even connects IEQ with staff performance and loyalty. This indicates that monitoring IEQ in office environments is a necessary measure that should be incorporated into office building design. Additionally, several studies have highlighted the importance of IEQ in office planning. Li et al. (2021) found that adjusting IEQ parameters could help achieve more efficient outcomes for employees by enhancing human comfort. This suggests that a specific focus should be placed on the effects of IEQ parameters to improve workplace performance (Choi et al., 2023; Ortiz & Bluysen, 2022). Furthermore, Seyedrezaei et al. (2023) argued that improved IEQ, with interactions involving perceived psychological comfort and gender, would lead to increased productivity. This implies that the weight of IEQ parameters may vary by gender. However, Fathi and O'Brien (2024) contended that, regardless of the weighting approach, workers' enhanced performance could be achieved by considering the four main IEQ comfort domains. This indicates that the use of IEQ in explaining office building design is widely recognised, with the aim of expanding further to foster productivity. Therefore, the application of IEQ in office design is essential and should not be underestimated, particularly in the post-pandemic era, when greater workplace flexibility is being integrated. In conclusion, this study emphasises that user needs are of paramount importance and that a competent facilities manager should oversee their management.

User Satisfaction and Business Success

The Centraal Beheer Building exemplifies user-centred, comfortable work environments (Weston, 2004). Considering user needs and involving users in the design enhances satisfaction (Köse Doğan, 2008). Spatial layout affects satisfaction, usage, and interaction (Ateş, 2020). Uncomfortable work areas increase strain, harming performance (Lamb and Kwok, 2016). Changes in space often accompany societal shifts (Tanalı, 2000). Good physical conditions, such as heating, lighting, and acoustics, improve service use, fostering security and focus.

Office environments greatly influence employee behaviour, with spatial design affecting cognitive and psychological responses (Kavuran, 2006). Human factors should be based on anthropometric, sensory, perceptual, and cognitive criteria. Environmental conditions- physical, biological, chemical, and psychosocial- are vital for ergonomic workspaces (Çete, 2004). Ignoring users' psychological and behavioural traits hampers performance (Aluçlu, 2000). Physical space features affect behaviour; personal traits influence how people use space. Ergonomics and space properties impact satisfaction and efficiency. Proper office organisation boosts productivity and satisfaction (Sakallı, 1997). Köse Doğan (2008) identified four key user requirements: dimensional, auditory, thermal, and visual, influencing satisfaction and motivation.

Yekanielibeiglou (2021) studied the impact of activity-based offices on productivity, while Karakurumer (2022) explored the influence of next-generation office designs. Karabulut (2022) analysed the role of shared offices in fostering belonging, and Sevimli (2021) highlighted pandemic-related changes in service and work systems, emphasising the rise of remote work. Pandemic-driven spatial decisions are key in designing and transforming offices. Post-pandemic, remote working is expected to remain prevalent, leading to adjusted office space use (Marr, 2020; Molla, 2020; Akça & Tepe Küçükoğlu, 2020).

User needs in an office are categorised as dimensional, thermal, auditory, and visual. Visual needs include static and dynamic measurements, actions, and lighting. Thermal needs include temperature, humidity, radiation, and airflow. Auditory needs concern sound levels and distribution. Space considerations cover user numbers, activities, equipment, and anthropometric and perceptual dimensions, which determine space requirements. Structural integrity and safety measures against fire, disasters, and theft are also essential (Koçer et al., 2016; Kaya, 2007; Çete, 2004).

According to İmal (2009), the physical requirements of users include spatial needs, bioclimatic (thermal) considerations, acoustic (auditory) requirements, and visual necessities. These characteristics may vary across societies, and factors such as habits, cultural influences, and technological opportunities also shape these needs.

Therefore, given the strong link between user satisfaction and business success, it is clear that office investments should prioritise technical infrastructures and technological equipment that meet user needs. Office environments that ensure user satisfaction provide opportunities for long-term sustainable use and demonstrate effective design. This significantly boosts employee productivity and motivation within the office.

Real Estate Management

Offices developing and constructing should follow professional management principles, with strategic planning and implementation. Conducting feasibility studies, needs analyses, and designing according to operational frameworks is recommended (Keskin et al., 2023). Identifying spatial resources and needs and then developing practical approaches for operational phases is crucial (Demirkaya, 2020). Facility planning and management combine architectural, interior, product design, organisational, and environmental psychology disciplines to solve related problems (Becker, 1981).

Real estate management covers financial oversight, change management, human resources, health and safety, contract administration, and maintenance (Barrett, 1995). Since design, location, capacity, and construction vary for each office project, it's crucial to have management teams capable of long-term responsibility, considering facility management. Beyond physical traits such as spatial layouts and distributions, factors like investment, operational costs, service scope, and maintenance needs differ across buildings. Effective management requires collecting and analysing building data, identifying issues, and proposing solutions. Facility management is especially vital for office buildings due to continuous use, high user density, and complex technological infrastructure, making professional management essential.

METHODS AND DATA

The study used a survey based on findings from a literature review. Data were collected through face-to-face surveys in historic districts such as Kızılay and Ulus, and in modern zones such as Eskişehir Road, Konya Road, and Çukurambar. It focused on space use, management, and user satisfaction in traditional offices and contemporary developments. Ankara's office market is the second largest in Turkey, vital to commerce and government. Office projects are expanding in new CBD areas such as İskitler, Söğütözü, Balgat, Çukurambar, and Mustafa Kemal Pasha, while traditional styles persist. Results are presented (JLL, 2025).

Sampling results showed that surveying 1,000 individuals was sufficient, including 460 in plaza-style offices and 540 in private offices. Surveys with 50 office managers and 10 facility managers verified data consistency. The sample size was based on an effect size (w) of 0.13, significance level (α) of 0.05, power ($1 - \beta$) of 0.93, and degrees of freedom (df) of 4, leading to a minimum of 1,010 participants. Data from 1,000 valid respondents met this target. Reliability was assessed via a pilot study with 30 participants, yielding a Cronbach's alpha of 0.928, indicating high reliability. An a priori power analysis using G*Power 3.1 supported the study's validity. Feedback from 50 managers helped validate findings. Results are presented numerically and proportionally, ensuring clarity.

Case Ankara Province: Office buildings and their spatial distribution

Significant fluctuations in the production of office buildings in Ankara Province over the past two decades reflect changing demands and evolving spatial trends. Regional disparities, economic conditions, and demand for commercial office space primarily drive fluctuations in office construction. Notably, since 2020, demand for office space in Ankara has increased markedly, accompanied by a rise in the number of office buildings and the total office area. Specifically, the number of office buildings grew from 80 in 2000 to 123 in 2021, 212 in 2022, 226 in 2023, and 89 in 2024, as detailed in Table 1.

A primarily linear relationship exists between total and active populations. Analysing Ankara's demographics shows that service-sector employees—key to office investments—are crucial to the city's economy. This reflects the absolute number of employed rather than their share. Likely, a future need for office space will develop.

Table 1 Analysis of office projects produced in Ankara Province (TURKSTAT, 2025a)

Years	Ankara						
	Total Office Area Produced (m ²)	Number of Office Projects Produced	Total Population of Ankara	Active Population	Agriculture (%)	Industry (%)	Services (%)
2010	262,331	259	4,771,716	3,384,382	3.7	23.6	72.7
2015	1,691,388	328	5,270,575	3,740,305	3.6	24.5	71.9
2020	489,584	80	5,663,322	3,980,027	3.2	23.5	73.3
2021	555,966	123	5,747,325	4,047,127	3.8	24.5	71.7
2022	1,138,041	212	5,782,285	4,088,670	3.1	25.4	71.4
2023	1,075,038	226	5,803,482	4,117,385	3.8	26.4	69.7
2024	1,495,496	89	5,864,049	4,169,679	4.4	25.8	69.9

In Ankara, there have been observable changes over time in the number of office building projects and the units within these projects. Notable fluctuations in the overall utilisation of unit areas have been detected, especially during the post-COVID-19 pandemic period commencing in 2021. Projects developed during this timeframe exhibited an average area per project, considering building dimensions, ranging from 4,500 to 5,500 square meters. The upward trend in average project area over the years correlates with the development of large-scale office projects.

The distribution of office assets in Ankara Province is complex, with diverse locations and dispersal patterns of traditional and modern offices. Professionally managed offices are mainly concentrated along Eskişehir and Konya Roads, as well as in key districts such as Balgat, Çukurambar, and Mustafa Kemal Paşa. The Class A office stock, which was about 640,000 m² in 2015 and mostly professionally managed, has grown to over 2.0 million m². With ongoing projects, this is expected to reach 2.3 million m² by 2025, and about 70% of office assets are located in designated new-stock areas.

In Ankara Province, thirty office buildings were assessed based on capacity and total usable area. The average capacity per project is about 220 units, with an average unit area of 400 m² and a total average project size of 82,500 m². The largest project, Merkez Ankara, includes 1,429 units and 300,000 m². Office unit areas mostly range from 200 to 250 m², including common areas (Demirkaya, 2024; JLL, 2025; TURKSTAT, 2025b).

Case Ankara Province: Management and Characteristics of Office Buildings

Land costs constitute a significant share of total investment in office buildings, which are commonly located in urban city centres or designated central business districts. Elevated land prices frequently lead to the development of multi-storey structures and higher building densities. The management of these multi-storey office complexes, which are often regarded as symbols of prestige owing to the specialised technologies and construction materials employed, varies according to factors such as the site size, number of floors, and spatial configuration. Consequently, the necessity for professional facility management becomes apparent in large-scale office environments.

In small office projects, management usually follows traditional methods based on autonomous units and shared areas, as per Condominium Law No. 634. Different parties own units, often managed by untrained appointed managers. Large projects have more complex ownership and management systems. Facility management, though new in Türkiye, has evolved with modern office uses. Traditional systems typically involve owners or individual managers handling each office, leading to two main management categories. An investigation examined spatial use within these groups to resolve issues.

Leasing is preferred for many projects, but independent units owned by different individuals are common. When ownership is spread, management can be chosen collectively. Professional management teams are often used in lease-focused projects with single or a few investors, to diversify inputs and meet diverse needs. Managing office buildings is complex, involving financial, administrative, technical, legal, and social factors. Thus, experienced, professional managers are preferred for large-scale projects.

RESULTS

This section first presents the findings regarding the Impact of COVID-19. Findings on User needs follow this, and finally, findings on the Effects of change on office employees and managers.

Impact of COVID-19

Office employees surveyed about pandemic work changes, shown in Table 2. 66.9% reported modifications in their work environment. They selected multiple options, with remote work (51.7%) and hybrid arrangements (43.2%) as the most common. Spatial arrangements were introduced to support social distancing, allowing office work if protocols were followed. Some staff worked remotely, while others adjusted social distancing and hours to stay productive. An alternative was using extra space from spatial reconfigurations for office operations, with participants asked about their need for additional space.

Table 2 Status of changes in working conditions during the COVID-19 Pandemic

	Number (n)	Rate (%)	Number (n)	Rate (%)	Number (n)	Rate (%)
Yes	331	72.0	338	62.6	669	66.9
No	129	28.0	202	37.4	331	33.1
Total	460	100.0	540	100.0	1,000	100.0
Changed Conditions	Professional Office Building		Individual Office		Total	
	Number (n)	Rate (%)	Number (n)	Rate (%)	Number (n)	Rate (%)
Rotational work	207	45.0	225	41.7	432	43.2
Remote work	244	53.0	273	50.6	517	51.7
Staff reduction	25	5.5	28	5.1	53	5.3
Temporary suspension of activities	37	8.0	60	11.1	97	9.7
Mixed	-	-	5	0.9	5	0.5

Defining user needs

The change in office habits during the pandemic was driven by evolving needs, including maintaining environmental conditions, ensuring isolation, and facilitating communication. Creating a safe, comfortable space with reliable internet became a top priority. Basic office needs remain essential for employee satisfaction. Services and conditions were analysed for two work groups with different styles, showing that needs vary by office type. Fulfilling these needs affects user satisfaction and demand for office space.

Effects of change on office employees and managers

In office environments, user requirements are shaped by various circumstances. Factors such as the purpose of space use, duration of occupancy, accessibility, location, and individual preferences and

expectations influence the needs that may arise when engaging with the space. The transformation of work environments during the pandemic has markedly affected space utilisation; the changed working arrangements, in turn, have led to a shift in perspectives on space and altered expectations. This new situation has influenced the management and use of office environments, necessitating adaptation to the evolving conditions. Table 3 presents their expectations for changes in office environments during the pandemic. Their expectations mainly focused on aspects of space use related to heating, lighting, and ventilation. These expectations were chiefly aimed at improving comfort conditions within the occupied space.

Table 3 Deficiencies in the functionality of office spaces and recommendations

	Rate (%)	Rate (%)	Rate (%)
Other	21.8	6.7	15.0
Fire Escape	7.3	20.0	13.0
Heating	7.3	15.6	11.0
Lighting	14.5	11.1	13.0
Elevator / Lift	7.3	4.4	6.0
Parking	5.5	4.4	5.0
Excessive Technical Breakdowns	12.7	6.7	10.0
Cleanliness / Tidiness	18.2	26.7	22.0
Ventilation	5.4	4.4	5.0
Total	100.0	100.0	100.0
Recommendations	Professional Office Building	Individual Office	Total
	Rate (%)	Rate (%)	Rate (%)
Other	23.6	33.3	28.0
Make Adequate and Functional / User-friendly	36.4	33.3	35.0
Install / Improve Insulation	7.3	11.2	9.0
Resolve Technical Problems	18.2	6.7	13.0
Install / Improve Lighting	5.5	4.4	5.0
Increase Size / Make Larger	9.0	11.1	10.0
Total	100.0	100.0	100.0

Table 4 presents participants' responses on the essential features offices should have, allowing multiple selections. Functionality (27.6%) was identified as the most important aspect expected from offices. This was followed by technological infrastructure adequacy (16.3%) and ease of access (16.3%). Additionally, modern design (15.2%), the inclusion of social areas (12.0%), and comfortable conditions (10.1%) were also considered important by employees. These results suggest that users' expectations of office spaces extend beyond physical conditions to include technological features, accessibility, and quality-of-life enhancements.

Table 4 Recommended criteria for consideration in new office projects

	Number (n)	Rate (%)	Number (n)	Rate (%)	Number (n)	Rate (%)
Technologically Adequate	74	16.0	90	16.6	163	16.3
Comfortable & Convenient	51	11.0	51	9.4	101	10.1
Easy Commute	90	19.5	73	13.6	163	16.3
Presence of Social Areas	81	17.5	39	7.2	120	12.0
Modern Design	74	16.0	78	14.5	152	15.2
Functional	120	26.0	156	28.9	276	27.6

To identify attributes that could guide office investments specifically within Ankara Province, participants were asked about the features that ideal office buildings should possess. By allowing multiple responses to the questions, the aim was to gauge the importance of these features and perceived needs realistically. According to Table 5, social amenities (75.9%) rank as the most

demanded feature in offices. This is followed by environmentally friendly green building attributes (62.3%), meeting security requirements (54.0%), the availability of parking and valet services (50.1%), adequate technical infrastructure (45.7%), the fulfilment of physical and functional criteria that enhance user productivity (43.9%), and the establishment of professional management structures (40.9%). These findings indicate that user expectations are not confined to basic physical needs; they also emphasise sustainability, security, comfort, and effective management.

Table 5 Production needs and characteristics of new office buildings in Ankara Province

	Number (n)	Rate (%)	Number (n)	Rate (%)	Number (n)	Rate (%)
Social amenities/opportunities	343	74.5	416	77.0	759	75.9
Technical infrastructure	246	53.5	211	39.1	457	45.7
Compliant with productivity criteria	214	46.5	225	41.7	439	43.9
Subdividable (space)	101	22.0	106	19.6	207	20.7
Security	288	62.5	253	46.8	540	54.0
Mixed tenant structure	74	16.0	37	6.8	110	11.0
Single ownership	101	22.0	53	9.8	154	15.4
Professional management structure	170	37.0	239	44.3	409	40.9
Parking and valet services	223	48.5	278	51.5	501	50.1
Healthcare	161	35.0	92	17.0	253	25.3
Restaurant/Café	182	39.5	138	25.5	320	32.0
Reception / Meet and greet services	124	27.0	119	22.1	244	24.4
Accommodation services	87	19.0	64	11.9	152	15.2
Green building (attributes)	306	66.5	317	58.7	623	62.3
Options for alternative/flexible office use	74	16.0	83	15.3	156	15.6
Availability of sports and recreation areas	110	24.0	73	13.6	184	18.4

The survey shows 66.9% of respondents experienced changes in their work methods, including remote work (51.7%), hybrid work (43.2%), temporary suspensions (9.7%), and staff reductions (5.3%). This indicates increased use of remote and hybrid models. Participants reported issues like cleanliness (22.0%), fire-escape access (13.0%), lighting (13.0%), and technical faults (10.0%). Solutions suggested include process improvements (35.0%), fixing technical problems (13.0%), better insulation (9.0%), and lighting upgrades (5.0%). For new office features, respondents prioritised functionality (27.6%), technology (16.3%), transportation (16.3%), and modern design (15.2%). In Ankara, preferred features for new offices included social facilities (62.3%), green certification (54.0%), security (50.1%), parking (45.7%), efficiency standards (43.9%), and professional management (40.9%). Overall, there's demand for well-managed, functional, and user-friendly office spaces.

DISCUSSION

This study aimed to describe the post-pandemic office market in Ankara Province, Türkiye. Specifically, it analysed pandemic-induced changes in spatial deployment, identified emerging spatial requirements, and evaluated these factors from the perspectives of office employees and facility managers. With the shift to remote working (51.7%) and alternative working (43.2%), changes were observed in how offices are utilised and in office spatial needs. This suggests that the future office's spatial size may not need to be as large as it is now, but it should still offer attractive functionality. Notable choices during the pandemic included decisions on the use of cleaning products and technology to address deficiencies in office space functionality and issues requiring

resolution. The features considered for new office standards—such as functionality (27.6%), technology (16.3%), and easy access (16.3%)—have been deemed to require professional management.

The findings highlight that ensuring comfort and maintaining functionality are key in office space use. Effective space management facilitates efficient work processes. Work comfort directly affects productivity (Gerçek, 2019), so aligning the environment with user expectations is crucial. Providing proper spatial infrastructure improves comfort and conditions (Baş and Kayan, 2023). Comfort involves regulating environmental factors like heating, lighting, acoustics, and ventilation. Designing and supporting technical infrastructure increases satisfaction (Solomon, 1985; Preiser, 1993). With diverse services, a central professional team is preferred over individual office provision, offering management and economic benefits (Calvao et al., 2016). This study examines user expectations and management criteria for future office buildings in Ankara. User satisfaction shows spatial planning impacts both the physical environment and management. Proper investment in space design yields technical, financial, and employee satisfaction benefits, reduces managerial workload, and minimises disruptions (Demir Uslu 2022). Effective spatial arrangements meet user needs, improving office experiences, saving time, and increasing productivity.

CONCLUSIONS

Within the scope of this study, considering the effects of the COVID-19 pandemic, findings were obtained regarding how office spaces can be designed with appropriate management strategies in Ankara. It was found that remote working methods, which became widespread during the pandemic, were adopted to a limited extent in Ankara after the pandemic, and most employees continued working in physical offices. Conversely, office locations have shifted due to rising rental prices and office expenses, with a discernible shift towards individual office use. Nevertheless, in light of user expectations, it has been established that the demand for office buildings equipped with modern and technological infrastructure — including social space facilities, security services, parking and valet services, technical infrastructure, and efficiency standards — and managed through professional facility management is on the rise. This situation highlights the importance of designing future offices with user-focused, technically equipped, and managerially sustainable frameworks.

User expectations can be categorised under headings such as accessibility and location, the provision of expected services, the offering of comfortable conditions, and the creation of a sense of belonging for the user. However, as each building exhibits distinct functional and structural differences, such analyses must be conducted at the project level, specific to each building or group of buildings.

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AI DECLARATION

No artificial intelligence-based tools or applications were used in the preparation of this study. All content of the study was produced by the authors in accordance with scientific research methods and academic ethical principles.

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The Management of Mixed-Use Buildings in the Case of Skopje

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ABSTRACT

Background and Aim. There is strong interest from foreign and domestic investors to invest in complex mixed-use commercial facilities. This study researches the problem of analysis and estimation of tenant and lessor capacities from the perspective of management of real estate facilities. These specifics are highly related to counselling in the initial and pre-development project phase where previously carefully conducted analysis of input data is essential for successful facility management.

Methods and Data. The study explores the multidisciplinary approach of integrated socioeconomical aspects, commodity super flow, investment in mixed-use buildings and the hybridization between residential and commercial real estate. A case study of three locations in Skopje: Cevahir Mall, East Gate Mall and Diamond Mall, offers comprehensive analysis from the observation. Descriptive survey methods are used in the management of complex facilities to realize the demand for a “product” in the market. Through observational trials this exploratory study examines the importance of facility management in the process of designing mix used hybrid buildings.

Originality. To explore the aspects of management of mixed-use buildings, this research intends to conclude the points that make it successful. Considering the existing knowledge of this research problem, initial research is conducted on a newly identified phenomenon of mixed-use structures that shape the social and urban landscape.

Practical and Societal implications. The results of this paper aim to offer a plausible method to comprise all facility management services along with comprehensive administrative support and technical facility maintenance.

Type of Paper. Technical

KEYWORDS. facility management, mixed-use buildings, real estate management

INTRODUCTION

Managing the creation of mixed-use spaces presents unique opportunities in the real estate industry. These dynamic environments, which in cases such as ones in this paper, combine residential and commercial facilities, influence socioeconomic condition in the cities and require a nuanced approach to property management. This study explores and widens the scope of facility management in the preliminary evaluation of site location and socio-economic impact of the facility through its program mix. Thus, it dwells into the identification of factors which influence the design and formats of the mixed-use buildings, from their start as an architectural project to building maintenance and management program.

In order to explore the appropriate practices and strategies for effective management, two aspects of mixed-use structures are taken in regard. First is the necessity of economic profitability assessment of mixed-use spaces as real estate and their commodity value on the market while also considering their location. The second, more tangible aspect, is the exploration of urban qualities of these structures.

That being said, new city shopping centres with mixed-use purposes, whose “public spaces” remained in private ownership, are taken over by the city and remain accessible for everyone (Wall, 2005, p.149).

Is there any interdependence between a particular program mix and its market value? These research questions should explore interdependence between program mix in our case study.

LITERATURE REVIEW

The main characteristics of location in the real estate market

In economic terms the notion of “Market” is described as the framework that enables the exchange of goods and services between individuals or organizations and typically involves money and profits. Historically, the locations where trade once happened were later named as trading centres. In addition to this, the land and buildings within the trade centres have become real estate (Wenzlick, 1965).

As such, one of the key features of real estate is immobility. Despite its nature, real estate holds value and can be bought or sold. This immobility has important consequences for investment, both in the short and long term, as its value is tied to the location. Unlike most goods, whose location-based value depends only on transport costs to reach a market, the value of land rises or falls depending on the level of development and decline of the surrounding area.

Therefore, could this market logic be applicable in the planning and creation of mixed-use spaces, consisting of shopping mall, apartments and offices? The study is organized into three chapters, each addressing this research question, through the roles of hypermarkets, facility management and retail space anchors.

Hypermarket and hyper commodity

In the United States, the hypermarket comes before the city. Moreover, it doesn't just serve the city, it shapes it. The hypermarket creates a new kind of commercial space, unlike the traditional markets that were central points in the cities. It refers to an expansive, commodity-driven environment that fosters an entirely different kind of social interaction (Baudrillard, 1994; Fischer, 2024).

The hypermarket as a concept helps illustrate what Baudrillard (1994) calls the “end of modernity.” Between 1850 and 1950, large, modern stores emerged in cities due to rapid advancements in transportation.

With time, open shopping centres in downtown cities were rapidly replaced by closed shopping centres in the newly erected suburbs. The Southdale environment, for instance, was quite unlike that of any other shopping centre. There was nothing suburban about it, except its location. Southdale uncannily conveys the feeling of a metropolitan downtown; Southdale Mall is not a copy of downtown. Rather, it is an imaginative distillation of what makes downtown magnetic: the variety, the individuality, the lights, the colour, even the crowds (Wall, 2005, pg. 99).

Key psychological aspect was important for Victor Gruen in designing a shopping mall, which is the feeling of them being outdoors, because one of the court's chief functions is to provide psychological and visual contrast and relief from indoor shops (Hardwick, 2010). It is supposed to function as the community's living room where many public events should be crowding (Ibidem). Gruen drew up plans that placed the mall at the core of a new development of apartment buildings, houses, schools, a medical centre, a park, and a lake.

Management of mixed-use facilities

The mixed-use developments, which integrate residential, commercial and administrative functions into a single environment, have emerged as a defining feature of the contemporary real estate market. As would Fenton (1985, p.5) refer: “The combination of multiple functions within a single structure is a strategy that has been repeated throughout history. The house over the store, the

apartment above the bridge, and the Roman bath are all examples of the tradition of combining two or more functions within the walls of a single structure.”

These spaces aggregate on the principles of commodity, as well as diverse revenue streams, and yet their complex composition presents unique opportunity for the management of project development (Lee, 2022; Geyer Jr., 2024), while facility management has narrowly focused on operations that relate to the management of a facility’s space, people, services, and utilities. Some definitions now include more portfolio-related processes like real estate strategy, capital program management, and lease administration. Effective management of such environments necessitates a multidimensional approach grounded in the several principles.

Strategic planning refers to a comprehensive management plan that should address maintenance cycles, security arrangements, and methods of internal communication. According to BGSF (2024), communication between stakeholders: residents, business owners and service providers plays a central role in sustaining a harmonious mixed-use environment. The dialogue in contemporary mixed-use property management and the adoption of integrated systems can significantly streamline administrative tasks such as rent collection, service requests, and tenant correspondence. Maintenance and safety are particularly complex, where security protocols must account for varied factors of occupancy and usage.

The financial property management must balance multiple income and expense categories. It needs to ensure financial viability by setting competitive rents, controlling operating costs, and planning for long-term capital improvements, all while maintaining service excellence. Equally, if not more important, is the community cultivation, mixed-use property management is improving when social cohesion is achieved between different user groups.

These properties are subject to continuous evolution due to shifting market trends, technological advancements, and regulatory changes. All these principles are integrated by technology, which functions as a tool and as a transformative agent (BGSF,2024).

The new anchors in retail space

Influenced by the Covid 19 pandemic the retail sector has undergone significant transformation in recent years. New shopping habits affected the traditional leasing and tenant structure of the shopping centres. The conventional anchor tenant, such as hypermarkets and department stores, have increasingly lost their influence as the key retail points, mostly due to the changing consumer interests. Property management company such as Sierra Sonae (2025) are developing more diversified leasing strategies that adapt to the evolving retail functions within the urban environment. They oriented toward exploring a much broader array of potential tenants, and not only focusing on alternative commercial brands. This would also include non-retail entities such as healthcare facilities, educational institutions, sports and fitness centres or attractions such as water parks. The new anchor tenants must provide meaningful mixed-use community and area integration, alongside economic returns and consumer trends (Cheung et al., 2021; Wegrzyn and Kuta, 2024; Vallapuram et al., 2022).

Sierra Sonae (2025) embraces this strategy by integrating anchor functions with daily life activities such as supporting work, leisure, health or housing. Such anchors are valued for increasing the viability of retail destinations. When the tenant mix is dynamic and diverse, the resilience of the retail project increases, insulating assets from economic vulnerability and shifting market conditions.

MATERIALS AND METHODS

This study presents qualitative research and descriptive analysis of influential factors in facility management of real estate with mixed-use properties. The theoretical elaborations from literature review and examples are the foundation for gradually revising existing architectural and real estate theories and frameworks that address facility and property management.

Through case studies, surveys and observations the study gathers data for descriptive research. The direct observation method incorporates two sources of data: first, analysing the spatial characteristics,

involving aspects of financial and property management of the shopping centres, illustrated by diagrams and graphs. Secondly, analysing the social aspect of these mixed-use properties, which are privately owned but are public buildings. The facilities of the case studies are investigated through a survey of the space users, where user satisfaction is assessed through the statistical technique - Analysis of Variance (ANOVA).

The mixed-use buildings in Skopje, Macedonia – a case study.

The rapidly growing population of Skopje in the 1960s, 70s, and 80s was served by a number of modern department stores, which were precursors to the anchor units found in later shopping malls. As a single points of purchase, these department stores offered a wide range of goods spread across multiple floors. Nowadays former department stores in Skopje have been repurposed, refurbished, fully or partially demolished, resulting in expressions far removed from their original forms.

The research focuses on three case studies of mixed-use shopping centres, which include shopping malls, residential areas, and business facilities: East Gate Mall and Living, Diamond Mall and Residence and Cevahir Sky City Complex (Figure 1).

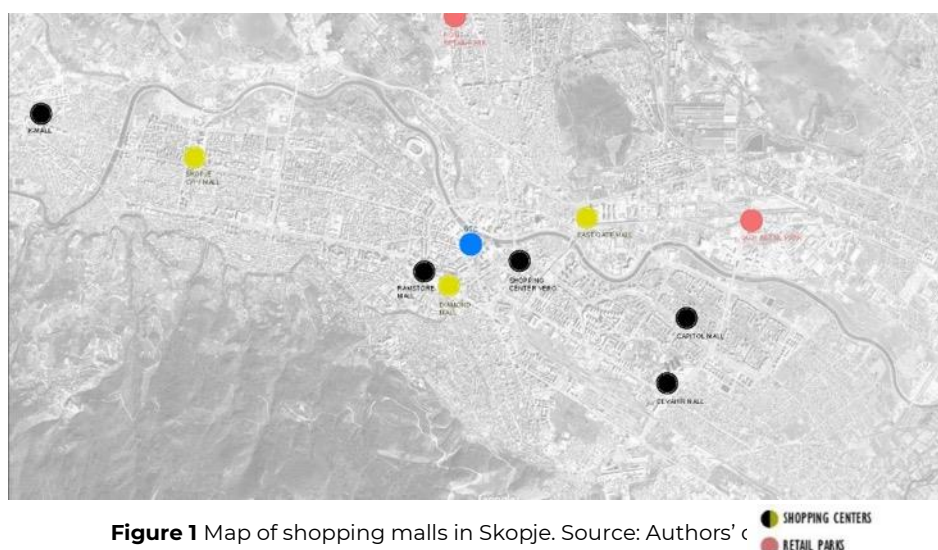


Figure 1 Map of shopping malls in Skopje. Source: Authors' c

Over the next three decades, various neighbourhood retail concepts, typically with shorter life spans and currently more focused on outlet programs, were introduced. The significant growth of the retail market in Skopje began in 2005 with the opening of the first "boxed" shopping centre, Ramstore Mall, located in a prime area of the city centre.

The retail market in Skopje is dominated by shopping malls with a 66% share, followed by neighbourhood centres with 19% participation of the total market supply, retail parks with 6%, and retail galleries with 5%. As of the first quarter of 2024, the total retail space supplies in Skopje amounted to 286,746 m². Of this, the modern retail stock, including shopping centres and retail parks, accounted for 215,154 m², with shopping malls contributing 198,554 m² and retail parks 16,600 m². The market density for modern retail space (shopping centres and retail parks) is currently 349 m² per 1,000 inhabitants, with projections indicating an increase to 455 m² per 1,000 inhabitants by 2026 (Nikolov, 2024; FORTONMKA, 2024).

Survey (One-Way ANOVA)

In the context of this study, the ANOVA technique uses a survey method to investigate the satisfaction of three groups of users. The first group are the tenants of the shops in the mall. Survey should represent their level of satisfaction with the conditions and retail possibilities in the shopping mall they have leased shop. The second group are residents-owners of the apartments in the buildings within the shopping centre complex. Survey should present their satisfaction of living and owning the property in the mixed-use complex. The third group are the citizens who live or work near the

shopping malls, where survey should present their satisfaction with the presence of mixed-use buildings nearby.

The survey (one-way ANOVA) can be applied in the following ways:

- Assessing Spatial Efficiency: Different case studies can be compared based on spatial efficiency.
- Analysing Social and Functional Outcomes: User experience surveys, foot traffic analysis, and public satisfaction data.

To describe the involved stockholder's opinion, the survey consists of three separate questionnaires, each with three sets of questions:

- The first set of questions investigates the influence of the proximity of the shopping malls in time and walking distances.
- The second set of questions assesses the influential factors on renting stores in the shopping mall or renting/buying apartments in the residential buildings.
- The third set of questions examines the satisfaction factor of all user groups of the shopping centres, shopping malls and residential areas.

Citizens' answers from the survey were collected using a Likert scale. Respondents rated their level of agreement or disagreement with the question on a symmetric agree/disagree scale. Out of 32 answered questionnaires, in terms of demographic data, 93% are aged 18–45, while 7% are aged 45–75. Furthermore, 28% of respondents live near shopping centres, other 34% live in the residential area of the shopping centre and 38% are the shopping mall tenants. All respondents are users of shopping centres. The data collection has been carried out at three characteristic locations, namely the following: East Gate Mall; Diamond Mall and Cevahir Mall. Surveys were conducted at various times, primarily between 10:00 a.m. and 2:00 p.m. and 4:00 p.m. and 6:00 p.m., by directly intercepting and surveying pedestrians on the locations, arbitrarily with no consideration of age and gender, rather, all willing participants.

RESULTS

For a comprehensive understanding of the correlation between facility capacity and visitor satisfaction, the following articles graphically and tabularly express the specifics of each built structure separately.

East Gate Mall and East Gate Living

According to the answers of the respondents, services in East Gate Mall and Living are: efficiency of the space leased and consistent full occupancy; stable foot traffic and growth in rental income.

Table 1 Data on mixed-use complex - East Gate Mall and Living. Source: FROTONMKA, 2024

Real Estate Management-Retail Agent:	BALFIN Group
Tenant mix:	220 (brands-stores)
Retail shopping area on leasing:	57.000 m ² .
Retail administrative area on leasing:	50.000 m ² .
Residential units:	1.600 m ² .
Car parking:	2.000
Gourmet area, SPA, Fitness centre...	1.000 m ² .
Greenery:	25.000 m ² .

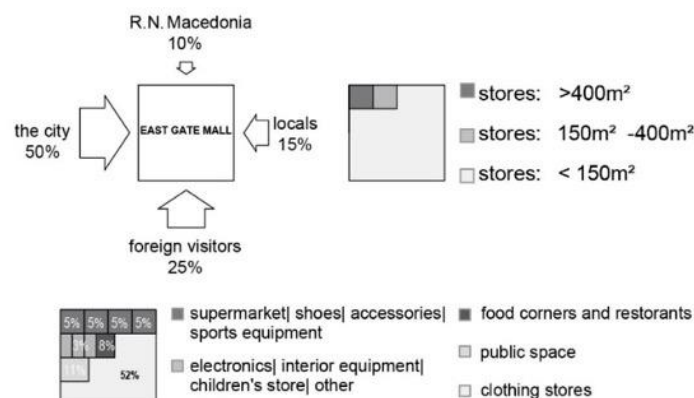


Figure 2 Graph diagrams of users, shop area and mixed-use content in East Gate Mall. Source: Authors' own work

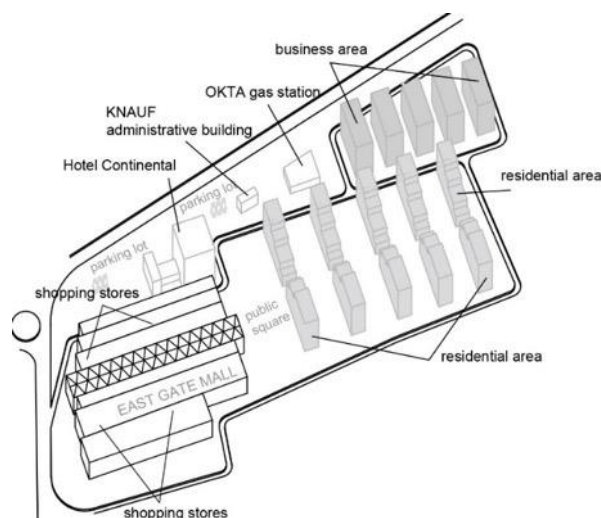


Figure 3 Isometric diagram of mixed-use content of East Gate Mall and Living.

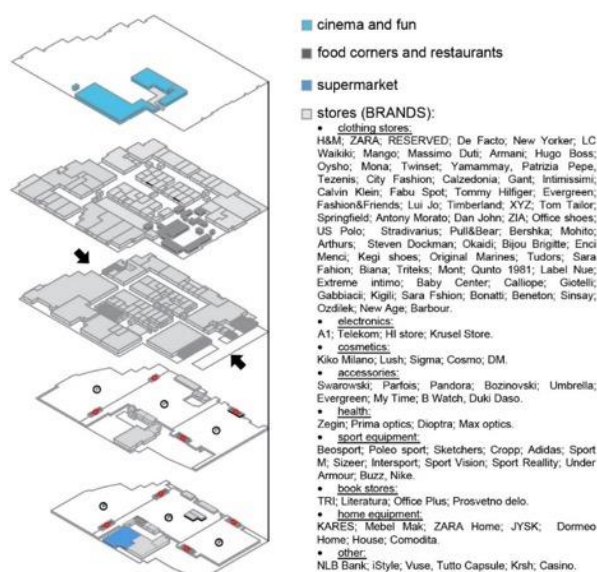


Figure 4 Isometric diagram of store Brands in East Gate Mall. Source: Authors' own work

Table 2 One-way ANOVA regarding different social groups in East Gate Mall and Living. The survey assesses the significance of the impact and importance of mixed-use centers for participants.

	Sum of squares	Df	Mean square	f -ratio value	p -value significance
Distance and time for transportation to the shopping mall.	30.1086 **	4	7.5271	5.2405	0.0013
The proximity of shopping mall within walking distance.	20.3636 **	2	10.1818	6.6932	0.0039
Anchor stores increase attractiveness of visitors.	2 *	1	2	5.9999	0.0498
Anchor stores increase the purchase price of real estate.	11.0054 *	3	3.6685	2.9655	0.0597
The anchor stores increases the attractiveness and profit.	0.4	1	0.4	1.6001	0.2415
The market price in relation to residential real estate.	4.571 *	1	4.571	4.7995	0.0489

Notes: *Difference is statistically significant ($p < 0.05$); **difference is statistically significant ($p < 0.01$); ***difference is statistically significant ($p < 0.001$)

Diamond Mall and Residence

According to the answers of the respondents, services in Diamond Mall and Residence are: efficiency of the leased space, but inconsistent full occupancy; stable foot traffic and growth in rental income; produce added value; becoming a key point of reference in Municipality of Centar and wider.

Table 3 Data on mixed-use complex – Diamond Mall and Residence. Source: FROTONMKA, 2024

Real Estate Management-Retail Agent:	LIMAK
Tenant mix:	180 (brands-stores)
Retail shopping area on leasing:	47.700m ² .
Retail administrative area on leasing:	/
Residential units:	792
Car parking:	3.200

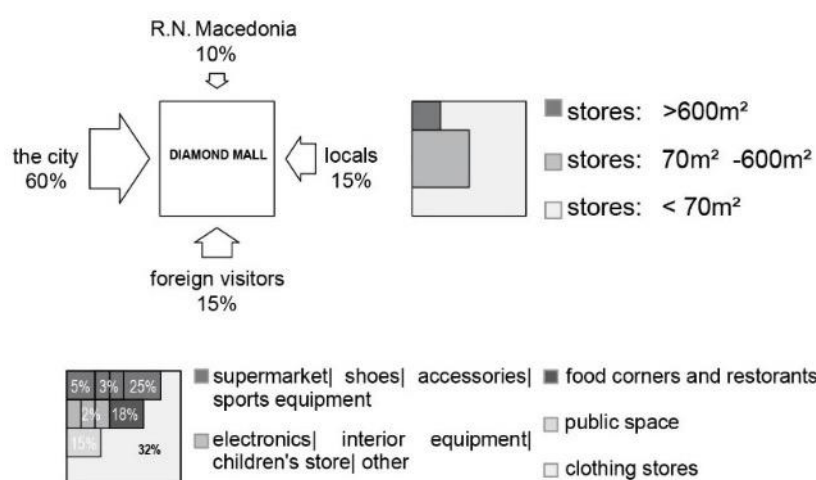


Figure 5 Graph diagrams of users, shop area and mixed-use content in Diamond Mall. Source: Authors' own work

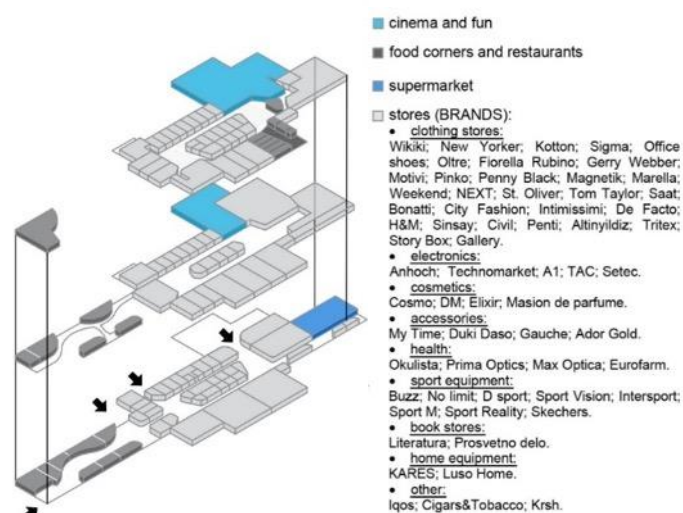


Figure 6 Isometric diagram of mixed-use content in Diamond Mall and Residence

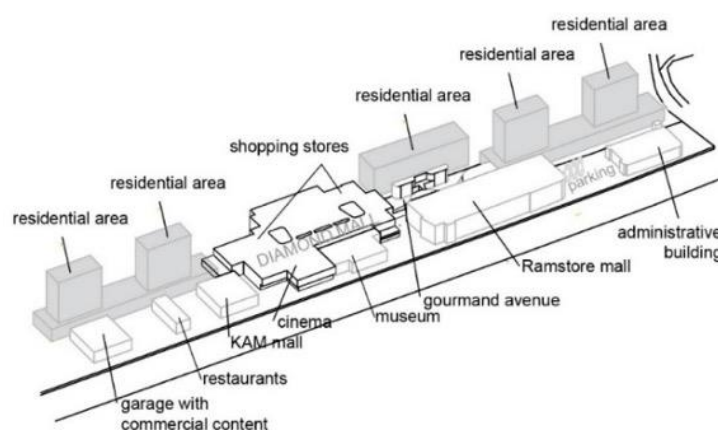


Figure 7 Isometric diagram of store brands in Diamond Mall. Source: Authors' own work

Table 4 One-way ANOVA regarding different social groups in Diamond Mall and Residence. The survey assesses the significance of the impact and importance of mixed-use centers for participants

	Sum of squares	Df	Mean square	f-ratio value	p-value significance
Distance and time for transportation to the shopping mall.	27.52 ***	4	6.88	7.8778	0.0001
The proximity of shopping mall within walking distance.	3.2	2	1.6	2.8609	0.0747
Anchor stores increase attractiveness of visitors.	0.4	1	0.4	0.2667	0.6195
Anchor stores increase the purchase price of real estate.	2.2668	3	0.7556	1.1827	0.3922
The anchor stores increase the attractiveness and profit.	0.667	1	0.667	3.9997	0.1161
The market price in relation to residential real estate.	6.125 *	1	6.125	6.3913	0.0448

Notes: *Difference is statistically significant ($p < 0.05$); **difference is statistically significant ($p < 0.01$); ***difference is statistically significant ($p < 0.001$)

Cevahir Sky City Complex

According to the answers of the respondents, services in Cevahir Sky City Complex are: positioned as a preferable leisure destination; engaging local residents in various activities. The Mall is anticipated to reach peak performance within 18-36 months of opening and have strong growth potential and value.

Table 5 Data on mixed-use complex – Cevahir Sky City Complex. Source: FROTONMKA, 2024

Real Estate Management-Retail Agent:	FORTONMKA
Tenant mix:	220 (brands-stores)
Retail shopping area on leasing:	11.000m ² .
Retail administrative area on leasing:	7.000 m ² .
Residential units:	1.376.
Car parking:	2.187

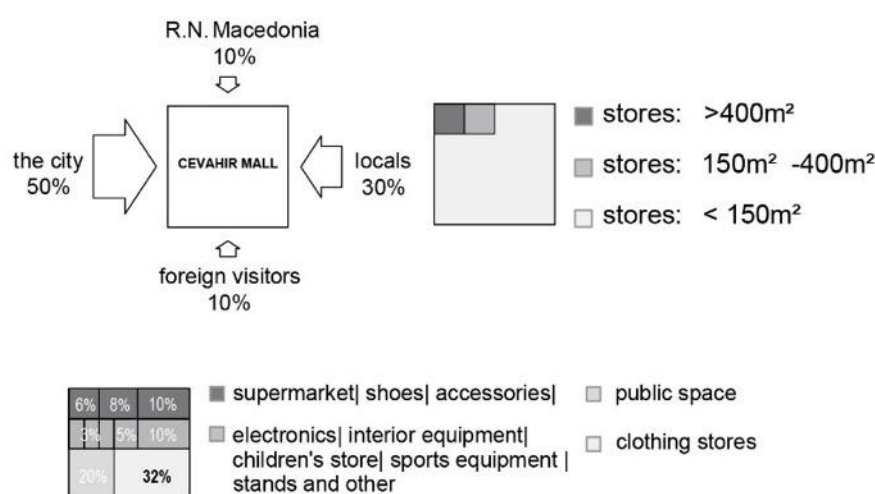


Figure 8 Graph diagrams of users, shop area and mixed-use content in Cevahir Mall. Source: Authors' own work

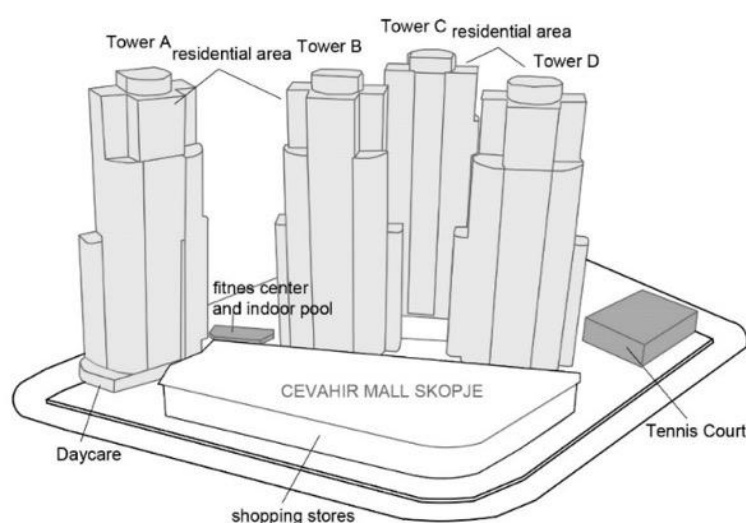


Figure 9 Isometric diagram of mixed-use content in Cevahir Sky City Complex.

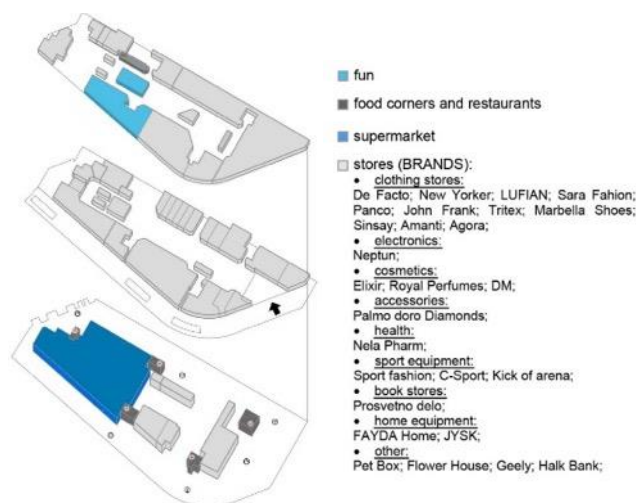


Figure 7 Isometric diagram of store brands in Cevahir Mall. Source: Authors' own work

Table 6 One-way ANOVA regarding different social groups in Cevahir Sky City Complex.

The survey assesses the significance of the impact and importance of mixed-use centers for participants

	Sum of squares	Df	Mean square	f -ratio value	p -value significance
Distance and time for transportation to the shopping mall.	47.5252 **	4	11.8813	11.4246	0
The proximity of shopping mall within walking distance.	2.9093	2	1.4547	1.5585	0.227
Anchor stores increase attractiveness of visitors.	2 *	1	2	8	0.03
Anchor stores increase the purchase price of real estate.	20.0115	3	6.6705	3.4353	0.0601
The anchor stores increases the attractiveness and profit.	2	1	2	1	0.3559
The market price in relation to residential real estate.	10.125 *	1	10.125	7.8385	0.0312

Notes: *Difference is statistically significant ($p < 0.05$); **difference is statistically significant ($p < 0.01$);
 ***difference is statistically significant ($p < 0.001$)

DISCUSSION

The study highlights key dynamics in managing mixed-use buildings in Skopje. Survey data and ANOVA analysis show that location and proximity, walking distance and transport connectivity are more influential for user satisfaction than anchor tenants. Anchor stores showed limited impact on retail appeal or residential property values in this context.

This suggests that the urban and social context outweighs tenant mix in determining the success of hybrid complexes. East Gate Mall and Diamond Mall, despite differing occupancy stability, benefit from centrality and integration with surrounding infrastructure, while Cevahir Sky City demonstrates that embedding projects as multifunctional urban nodes enhances legitimacy and value.

The findings also underscore the need for multidimensional facility management, balancing financial performance with liveability and community integration. Residents value both economic returns and social cohesion, requiring managers to foster inclusive environments that sustain long-term occupancy and loyalty.

Consistent with literature on hybrid real estate (Lee, 2022; Geyer Jr., 2024), the Skopje case shows that aligning spatial, social, and financial dimensions supports resilient projects meeting both investor and community needs.

CONCLUSION

This research examined how location, tenant mix, anchor facilities and facility management practises affect the planning and management of mixed-use building in Skopje. Based on three case studies and user surveys, the analysis shows that accessibility and proximity exert greater influence on user satisfaction than traditional retail anchors.

The results further demonstrate that mixed-use buildings in Skopje sustain stable levels of foot traffic and market interest when they are strategically located in the city. Residential units within these complexes are primarily evaluated through a market price, suggesting that the financial considerations are dominating the decisions for property ownership.

For developers, planners and managers, these findings emphasize the necessity of prioritizing location analysis, long term adaptability and stakeholder dialogue. Anchors should not be disregarded, rather reconceptualized as part of a wider program reflecting consumer trends.

Ultimately, the Skopje case illustrates that the resilience and success of mixed-use projects depend on their ability to operate as multifunctional urban hubs, balancing profitability with social integration.

Further research could expand on these insights by incorporating larger survey samples, studies of occupancy trends and comparative analyses, in order to contribute to refining the mixed-use building creation management as a response to evolving economic and social demands.

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Beyond the Cleaning: Exploring the Value Parameters of Repositioning Cleaning Staff from Back-Office to Front-Office Service Roles

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ABSTRACT

Background and Aim. While recent trends in facility management emphasize value creation over mere cost savings, the strategic potential of operational roles, such as cleaners, remains underexplored. Inspired by Vos et al. (2019) and the author's professional experience, this study investigates how repositioning cleaning staff to more interactive, visible roles can foster value for building users. This interaction may activate untapped capacities, adding value for client organizations while also improving working conditions and recognition for cleaners.

Methods and Data. An exploratory qualitative design was adopted. Eleven semi-structured interviews were conducted with senior FM, contract, and HR managers across various Dutch industries. Interviewees reflected on the potential impact of repositioned cleaners on FM/CREM value parameters (Jensen & Van der Voordt, 2017), supported by AI-generated visuals to ensure consistent understanding.

Results. Findings indicate that repositioning cleaners as front-service staff can create added value across key FM parameters, most notably in building user satisfaction, risk management and safety, health, corporate social responsibility, organizational image and cost.

Originality. This study contributes to the growing discourse on the strategic role of FREM in enhancing organizational value beyond traditional practices.

Practical Implications. By repositioning cleaning staff as front-service employees, organizations can unlock new avenues for value creation—aligning operations with broader strategic goals while also empowering cleaners and addressing key challenges faced by this workforce.

Type of Paper. Full Research

KEYWORDS. cleaning staff roles, employee Interaction, facility management, value creation, workplace sustainability

INTRODUCTION

Traditionally, Facility Management (FM) and Corporate Real Estate Management (CREM) have focused on cost control and operational efficiency. However, recent discourse has shifted toward value creation, emphasizing the strategic role of FM/CREM in supporting organizational performance (Jensen & Van der Voordt, 2017). This shift has led to frameworks that link FM to added values such as user satisfaction, productivity, adaptability, and brand image.

Despite growing interest in value-based FM, the role of cleaning staff in creating added value of Facility Management has received limited attention. Most studies address cleanliness as a technical outcome affecting satisfaction, productivity or image (Baričič & Salaj, 2014; Horrevorts et al., 2018; Nicholas et al., 2022) rather than considering cleaners themselves as contributors to organizational value.

An exception is Vos et al. (2019), who demonstrated that equipping train cleaners with communication skills and repositioning them as service-oriented staff enhanced the overall travel experience. Building on this insight and informed by the author's professional experience, this study explores how cleaning staff, once equipped and empowered for more visible and interactive roles, can be repositioned from back-office functions to front-service positions, thereby contributing to organizational value creation. The aim of this paper is to explore the value-adding potential of this repositioning from the perspective of client organizations, using the twelve FM/CREM value parameters. This job enrichment may not only increase their impact on client organizations but also help reduce persistent structural issues faced by this workforce, such as the invisibility of work, invisibility at work, and the stigma associated with "dirty work" (Rabelo & Mahalingam, 2019; Van Vlijmen, 2019). While these social benefits are important, the present study focuses specifically on the value-adding potential of such repositioning for client organizations, using the twelve FM/CREM value parameters introduced by Jensen and Van der Voordt (2017) as its analytical framework.

LITERATURE REVIEW

From Cost Control to Value Creation in FM/CREM

Facility Management (FM) and Corporate Real Estate Management (CREM) have evolved from a focus on operational efficiency and cost control to a broader strategic orientation centred on value creation (Jensen & Van der Voordt, 2017). Several classifications of FM/CREM added values have been proposed, including those by Lindholm (2008), Zwart (2011), and Coenen et al. (2013). Among them, the most comprehensive and widely adopted is the twelve-parameter framework introduced by Jensen and Van der Voordt (2017). This study adopts that classification to explore the potential value creation of cleaning staff repositioning in office environments.

Understanding Value Parameters in FM

The twelve parameters cover both tangible and intangible dimensions of FM performance. These include satisfaction, image, health & safety, productivity, adaptability, innovation, risk, cost, and sustainability, among others. Each parameter reflects a specific organizational need or stakeholder expectation. To support a focused investigation, each value parameter in the present study was linked to an established conceptual model. These models guided both the development of interview questions and the analytical framework. The following overview summarizes the main conceptual models used:

- Satisfaction: SERVQUAL – service quality dimensions (Parasuraman et al., 1988; Van Ree, 2010)
- Image: Corporate communication channels (Balmer & Gray, 2000)
- Culture: Cultural dimensions affected by FM (Van der Voordt & Van Meel, 2017)
- Health & Safety: Indoor environmental and safety parameters (Mansor & Sheau-Ting, 2022; Jensen & Van der Voordt, 2017)
- Productivity: Indoor Environmental Quality (Sullivan et al., 2013; Feige et al., 2013; Al Horr et al., 2016; Mbazor, 2020)
- Adaptability: Adaptive capacity of buildings (Van Ree, 2009; Geraedts et al., 2014; Coenen & Von Felten, 2014)
- Innovation & Creativity: Creative process and knowledge sharing (Sailer, 2011; Appel-Meulenbroek & Nardelli, 2017)
- Risk: Risk management strategies (Jensen, 2008)
- Cost Saving: FM-related cost domains (Redlein & Jensen, 2017)
- Sustainability & CSR: Triple bottom line (Dyllick & Hockerts, 2002; SPDI, 2021)

Role of Cleaning and Cleaners in FM Literature

While cleaning is acknowledged as a core operational component of FM, its strategic potential remains underexplored. Most studies have treated cleanliness as an environmental factor influencing satisfaction, productivity, or image (Hui & Zheng, 2010; Hui et al., 2013; Nicholas et al., 2022; Baričič & Salaj, 2014; Horrevorts et al., 2018; Kok et al., 2011; Price et al., 2003), rather than examining cleaners themselves as value contributors. A few studies have explored how cleaners' presence or behavior and communication with clients affects the perception of cleanliness (Whitehead et al., 2007; Whatley et al., 2012; Magnini & Zehrer, 2021; Vos et al., 2018), but the broader potential for value creation remains largely unexplored.

However, emerging research, notably by Vos et al. (2019), has shown that repositioning cleaners into more visible and interactive roles, such as hospitality-trained train cleaners, can significantly improve user satisfaction and the perception of service quality. These findings suggest that cleaners, beyond their technical output, can enhance user experience when empowered and integrated into service design. Moreover, cleaners represent a large and often undervalued segment of the workforce. In the Netherlands, over 247,000 people work in this field (SPDI, 2021), yet they face invisibility of work, invisibility at work, and dirty work stigma (Rabelo & Mahalingam, 2019; Van Vlijmen, 2017, 2019; Ashforth & Kreiner, 1999). Although this study focuses on organizational value parameters, the proposed role enrichment may also contribute indirectly to social sustainability and workforce dignity.

RESEARCH OBJECTIVE AND METHOD

This study explores how repositioning cleaning staff from back-office roles to front-service positions may generate added value for client organizations. Building on the twelve-value parameter framework by Jensen and Van der Voordt (2017)—excluding Asset Value, which was considered less relevant to this intervention—this study explores whether enhancing the visibility, interaction, and responsibilities of cleaners can amplify their contribution to organizational value creation. Compared to earlier work focusing on cleaners' own perspectives (e.g., Van Vlijmen & Van den Hoogen, 2013), this study adopts an organizational lens.

An interpretivist, inductive approach was applied to explore subjective organizational perspectives. A conceptual role was visualized, including daytime cleaning, service desk support, guest welcoming, issue reporting, and emergency guidance and used as a frame during interviews. It was assumed that cleaners would be adequately trained to fulfil these enriched tasks.

Eleven semi-structured interviews were conducted with FM, HR, and contract managers from office-based organizations across various sectors, including finance, technology, public services, education, logistics, energy, and facility management. All organizations employed over 500 people. Participants were selected using non-probability sampling due to the exploratory nature of the study. An overview of the interviewees is provided in Figure 1.

Interviewees										
1	2	3	4	5	6	7	8	9	10	11
HR manager	HR manager	HR manager	General manager	Facility manager	Contract manager	Facility manager	Facility manager	Contract manager	Facility manager	Facility manager
Client	Provider	Client	Provider	Client	Client	Client	Client	Client	Client	Provider
Logistic	Facility	Education	Facility	Finance	Education	Public sector	Public sector	Energy	Medtech	Facility

Figure 1 Overview of the interviewees

Interviews began with a description of the objective of the study. As preparation, interviewees had received a list of these 12 values before the interview took place. The interview started with an introduction, explaining the rationale behind the study, supported with AI-generated pictures to

illustrate the concept of repositioning cleaners (Figure 2), and a brief overview of barriers. The first question was “Based on this new role for cleaning staff, what impact and value can this change bring for the companies?” and follow-up questions specifically targeted the 12 added values of Jensen and Van der Voordt (2017) e.g. “Can repositioning cleaning staff in front-service roles, considering the provided explanations, have a positive impact on employee satisfaction? If yes, how?” Interviews lasted 50-70 minutes.

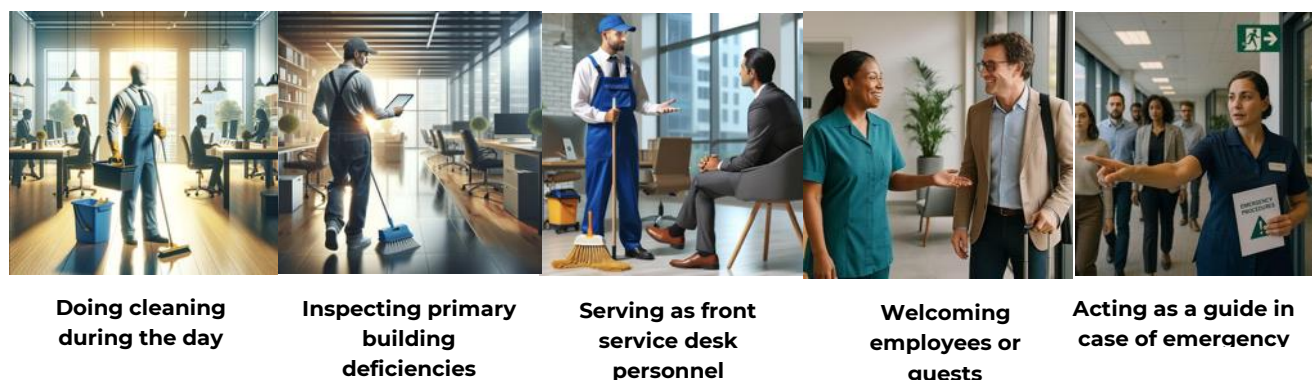


Figure 2 Visuals of the proposed transition in cleaners' role presented during interviews. Source: Authors using generative AI.

RESULTS AND ANALYSIS

The interview data were analysed using a structured qualitative process. Following Saunders et al. (2009), transcripts were coded through three key steps: condensation of meanings, categorization of themes, and narrative structuring. The thematic coding process began with coding perceived benefits (and challenges) of repositioning of cleaners. Open codes were then combined into axial codes, and linked to themes, being 11 of the 12 added values from Jensen and Van der Voordt (2017). This approach ensured that emergent insights were both grounded and systematically organized. Findings were then structured around eleven of the twelve FM value parameters introduced by Jensen and Van der Voordt (2017).

	HR manager			General manager	Contract manger		Facility manager				
	Client		Provider	Provider	Client		Client			Provider	
Interview Number	1	3	2	4	6	9	5	7	8	10	11
Employee satisfaction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Risk and Safety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CSR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Image	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cultural transition	—	✓	✓	✓	—	✓	✓	✓	—	✓	—
Adaptability	—	—	—	—	✓	—	✓	—	✓	✓	✓
Sustainability	—	—	—	✓	✓	✓	—	✓	—	—	—
Productivity	—	—	—	—	—	—	—	✓	✓	✓	✓
Innovation and Creativity	—	✓	—	—	—	—	—	—	—	✓	—

Figure 3 Overview of the added values of repositioning of clients. Source: Authors' own work.

The analysis revealed strong support for the added value potential of repositioning cleaning staff (Figure 3). Several value areas such as cost, risk, satisfaction, health, CSR, image, and employee satisfaction were recognized by all participants. Other parameters were discussed by at least two

interviewees, indicating broad conceptual relevance (see Table 1). Table 1 gives an overview of the added values of repositioning of clients. For each respondent, Table 1 indicates what their role is, and whether working for a client or a cleaning service. Thematic summaries per value parameter are presented in the following sections.

Employee Satisfaction

Employee satisfaction emerged as the most frequently discussed value parameter, with all interviewees reflecting on how the proposed role redesign could enhance service quality dimensions and, in turn, satisfaction. Several interviewees emphasized how front-service cleaners could restore the human element often missing in today's digital workplaces. Interviewee 3 noted, *"I think that [your idea] can affect empathy because now we just use letters and the letters are out of our souls and empathy is rare"*. Another common theme was enhanced hospitality through daily human interaction. Interviewee 2 mentioned, *"This interaction between cleaning and employees gives a feeling of personal caring to employees, which is really rare in today's office"*. Interviewee 9 added, *"They give more soul to the building. People make the soul, not the stones or bricks [...]. A happier office life with smiling cleaners"*.

The intervention was also seen as a way to improve *core cleaning* services. Interviewee 1 stressed that the study's proposed role makes full-day work in a single location possible for cleaners, which increases their engagement: *"They feel part of one team... more engaged, collaborative, willing to go the extra mile"*. Visibility was seen as a motivator: *"Working in front of others works like supervision and makes you have better performance"*. Interviewee 2 highlighted the effect on perceived cleanliness: *"When you are in contact with the employees, it makes the cleaner's performance transparent and affects the complaints"*. Furthermore, visibility was said to influence user behavior and indirectly support cleanliness: *"It's like a feeling of shame or pity when you make a mess and see people who clean it after you. You'd be more careful, especially if that guy is your co-worker"*.

Responsiveness was another benefit raised. Interviewee 9 explained, *"People don't like to fill out long forms [...] with this change you bring services closer"*. Speed of response was also noted: *"If there are problems [...] and a cleaning host can step in immediately, it increases satisfaction"*. Finally, the presence of empowered cleaners facilitates early detection of facility issues. As Interviewee 6 noted, *"They can see problems earlier than building users, which increases the reliability of building services"*.

Risk Management and Safety

Interviewees emphasized how the proposed role redesign could contribute to risk management by leveraging the cleaners' daily presence and equipping them with basic safety knowledge and communication skills. Positioned as *"the eyes and ears of the building"*, they are well-placed to detect and respond to potential hazards before they escalate. As Interviewee 9 explained, *"They can detect safety issues. For example, a chair is in front of the emergency door, and they can free the door or report it"*. Several participants also noted the value of integrating cleaning staff into emergency response teams. Given their constant presence in the office, they can act quickly in critical situations. Interviewee 6 stated, *"In the case of an accident, they can handle first aid immediately to lower the damages"*.

Health

Another line of reasoning highlighted the idea's potential to promote health by increasing awareness around hygiene. As Interviewee 8 remarked, *"The cleaners are like the representative of health and safety, and this change, like COVID, puts light on the importance of health and safety and maybe causes people to pay more attention to hygiene"*. In addition, some participants noted that the redesign enables cleaners to work full-time in one location, making hygiene interventions more immediate and effective. As Interviewee 4 explained, *"If the toilet is dirty, and you have a cleaner straight away, you can send them immediately instead of waiting for the evening. So the hygiene is much better during the day"*.

Corporate Social Responsibility (CSR)

All interviewees agreed that the proposed intervention could contribute meaningfully to CSR by improving working conditions in the cleaning sector. Beyond operational benefits, the new role was widely viewed as a step toward greater social responsibility. A frequently mentioned point was that the intervention would enable cleaners to work full-time at a single location, which brings advantages. Interviewee 6 noted: *"It helps the work-life balance of the cleaners. They work from 9 to 5. Then they are at home for their kids"*. Others emphasized the potential to improve the perceived status of the profession. Interviewee 5 pointed out: *"Your idea can affect the cleaning job stigma and totally, I think, make cleaners more satisfied with their job"*.

At the industry level, the intervention was seen as a way to attract new talent to the cleaning industry by enhancing the appeal of cleaning roles. Interviewee 8 remarked: *"By making cleaning more attractive with ideas like yours, the FM market can attract new people from other industries"*. This was echoed by Interviewee 4, who stressed the potential for better resource utilization: *"Because the labor market is tight, these ideas help to better utilize employees"*.

Finally, the intervention was seen as inclusive, with the potential to create opportunities for people distanced from the job market. As Interviewee 11 noted: *"Especially this idea maybe makes this kind of jobs so compatible for people with disabilities or people distant from the job market"*.

Organizational Image

The workplace can serve as a powerful platform for communicating organizational values. Several interviewees highlighted how the proposed role redesign could reinforce brand identity and employee connection to the organization. Interviewee 8 illustrated this by stating: *"When people come into the office, the company wants them to experience and feel the brand they are working in [...] Your idea related to cleaning staff can bring that to a high level and increase the feeling of brand experience in the daily presence of employees in the office"*. To elaborate, the same interviewee shared an example from a Dutch amusement park where themed waste bins engage children in cleaning as part of the entertainment experience. Similarly, integrating cleaning staff into visible, interactive roles could embed them in the workplace brand experience and reflect the organization's cultural values. In line with this, Interviewee 4 noted that the change *"can show the importance of connection in the company"*. Others emphasized how it signals appreciation for employees; *"It shows how important employees are for the company"* by offering a higher level of service. Interviewee 6 added that the idea could also enhance competitive positioning: *"This idea can show the difference of your company to others [...]. So this change can be used to show being the pioneer in every aspect"*.

Finally, all the interviewees emphasized that the proposed change signals improved working conditions for cleaning staff. In doing so, it reflects core organizational values such as People orientation and inclusion values that increasingly shape how companies wish to be perceived both internally and externally.

Cost Savings

All interviewees agreed that the proposed role redesign could contribute to cost savings in various ways. One commonly mentioned benefit was the potential to consolidate cleaning tasks during daytime hours, enabling earlier office closures and reducing energy use: *"Day cleaning allows for earlier office closures, reducing the need to keep the building and lights operational late into the evening, which can reduce a lot of costs"*. Several respondents also emphasized that expanding cleaners' responsibilities beyond traditional tasks could lead to operational efficiency: *"If you merge more profiles in one and you can manage it, all these tasks can be done without interruption for others and working together, and that saves not only money but also time"*. Others highlighted indirect savings, such as lower staff turnover due to increased job attractiveness: *"It causes reducing job turnover, which is an enormous saving"*. Lastly, Interviewee 9 noted that the role adjustment could help balance cleaners' physical workload *"Your idea also adjusts the level of physical activity for cleaners"* an insight further linked by Interviewee 8 to reduced sickness-related expenses.

Cultural Transition

Just as the physical workplace can support broader cultural change programs (Van der Voordt & Van Meel, 2017), increasing the visibility of cleaning staff can enhance its potential to contribute to cultural transitions. Interviewee 2 highlighted their symbolic role in embedding new values: “People see them. So when a company wants to make some changes, these people can be a frontline person that reflects these changes in themselves and their behavior towards employees”. Several participants noted that the proposed role could be particularly useful when organizations seek to shift toward a more informal or less hierarchical culture. As Interviewee 10 explained: “To make our organization more flat we can use such services. With this change we don’t see a high hierarchy or top-down relationship, but more like the flat or the horizontal relationship”. Another aspect raised under this value parameter was the potential of front-service cleaners to support the adoption of day cleaning practices; a shift that still encounters resistance in many organizations. Interviewee 7 emphasized: “Your idea makes the day cleaning more feasible and reduces the number of complaints. With the bond between cleaners and employees, day cleaning becomes more acceptable and efficient.”

Adaptability

Roughly half of the interviewees recognized the potential of the proposed intervention to enhance organizational adaptability. Two key aspects were highlighted. First, repositioned cleaning staff could support employees during workplace changes, such as moving to a new office or adopting a new layout, by serving as informal guides. As Interviewee 5 noted: *“If your concept is the person knows many things about the office, they can help to implement a new change and help people to adapt to it fast”*.

Second, their presence was seen as an operational asset for the FM team, providing extra capacity to adjust service levels in response to changing occupancy patterns. Interviewee 8 explained: *“Now you have cleaners during the week; based on the crowdedness of different floors, the facility team can use them for maintaining the quality of services in all areas of the office [...] It helps the flexibility of the facility team which supports adaptability of the company”*.

Sustainability

Four interviewees discussed the potential environmental impact of the proposed intervention. One commonly mentioned benefit was the reduction in commuting-related emissions. By integrating multiple support roles into a full-day cleaning position, fewer trips to the office would be required. As Interviewee 9 explained: *“We have three employees. One for the restaurant. One for the coffee. One for the plants. They all came with a car. When we merge these tasks and turn cleaning into a full-day job, it can affect the number of trips, which affects the environment”*. Another sustainability gain stems from how the proposed intervention makes day cleaning more feasible—ultimately enabling shorter building operating hours and reduced energy use. As Interviewee 6 noted: *“The building and the lights are from 6 in the morning to 8 p.m. open. But with day cleaning, we can shorten this time. So there’s a lot of savings in energy and cost from a sustainability perspective”*.

Productivity

Whereas none of the HR professionals directly linked the intervention to improved productivity, several FM respondents emphasized its indirect impact. The continuous presence of a front-service cleaner near employees can help reduce disruptions caused by small workspace issues. As Interviewee 8 noted: *“If you enter a room and it’s dirty, with empty cups lying around, you start off wrong. That costs time and causes irritation for people. But if there is someone who can quickly fix issues, like a problem with the cables, it reduces wasted time and positively affects productivity”*. Others suggested that the intervention raises the overall service level, allowing employees to focus more fully on their tasks, which in turn contributes to better performance.

Innovation and Creativity

Creativity was the least frequently discussed value parameter, though a few interviewees did highlight relevant connections. Interviewee 3 suggested that the intervention could promote a culture of cross-functional collaboration, an environment often conducive to innovation:

“Repositioning cleaning staff could encourage cross-functional collaboration and teamwork... it implicitly encourages communication between employees”. Interviewee 10 emphasized that the proposed intervention would elevate the overall service level in the workplace, thereby reducing daily distractions and enabling greater mental focus. As they put it: “If you give me a good environment, a healthy environment, and somebody who is well trained, I will be having my own time without any worries to think about new innovations”.

Challenges

Though not the focus of the interviews, six interviewees did mention challenges, such as expected resistance, language barriers, skills and knowledge gaps and language barriers of cleaners, maintaining quality standards, difficulty in recruiting staff, and effect on contracts in case of multiple service providers.

DISCUSSION

This study builds on the value framework of Jensen and Van der Voordt (2017) and extends the findings of Vos et al. (2019), reaffirming that repositioning cleaning staff may positively influence nearly all FM value parameters. A key contribution lies in operationalizing FM’s value-adding role. By targeting one of the most task-oriented and often overlooked roles—cleaning—this research shows that value creation is not confined to strategic planning or high-level decision-making. It can also emerge from thoughtfully redefining frontline roles. This highlights the capacity of all FM layers, including tactical and operational, to contribute to broader organizational goals.

SPDI (2021), a Dutch institute focused on sustainable labor strategies, identifies task broadening as a key approach to enhance the long-term employability of cleaning staff. This study offers a concrete illustration of how that recommendation can be put into practice. By repositioning cleaners into enriched, front-facing service roles, the study shows not only how job quality can be improved, but also how such changes can generate organizational value. In doing so, it strengthens the case for task broadening, not just as a socially motivated initiative, but as a business-relevant strategy for facility and HR managers alike. Ultimately, this research serves as a value opportunity map for FM and HR professionals. By connecting each value parameter with practical examples and user perspectives, it provides a hands-on guide for adapting service roles to support strategic priorities. For instance, if an organization seeks to improve employee satisfaction or employer branding, this framework illustrates how an enriched cleaning role—backed by training—can help deliver on those goals. With its low cost, high visibility, and strong symbolic potential, the intervention presents a pragmatic way for organizations to create tangible value through minimal investment.

Limitations

This study was exploratory in nature and subject to several limitations. It focused on office environments in the Netherlands, limiting transferability to other cultural or sectoral contexts. The intervention remained conceptual, with participants relying on visual aids, which may have led to varying interpretations. Data was gathered through eleven interviews with senior FM and HR managers, excluding frontline perspectives that might have added nuance. Furthermore, the limited number of interviews and the focus on added value may have created bias. As a qualitative study, findings are based on perceived potential rather than measured outcomes. Implementation feasibility, costs, or resistance were beyond this study’s scope and warrant further research.

CONCLUSION

This study explored the value-creating potential of repositioning cleaning staff as front-service employees, assuming they are adequately trained and prepared for this expanded role. Based on the 11 value parameters of Jensen and Van der Voordt (2017), the findings suggest that such a role transformation holds the potential to enhance a broad spectrum of organizational values, including employee satisfaction, risk management, health, CSR, corporate image, cost efficiency, cultural transition, adaptability, sustainability, productivity, and innovation. The study also expands the

application of value-adding management theory in FM by demonstrating its relevance in highly operational domains. In doing so, it introduces a new lens for integrating service design, value creation, and workforce empowerment, particularly relevant for FM and HR professionals seeking win-win solutions that benefit both organizations and service staff. Future research should investigate implementation costs, long-term career impacts, and cross-sector applications, while also exploring legal and ethical considerations. It is equally important to examine the perspectives of cleaning staff themselves, particularly how they experience and evaluate such a role transformation in terms of empowerment, workload, and professional identity. Quantitative studies, pilot projects, and longitudinal tracking are recommended to further assess the practical implications of this transformation.

AI DECLARATION

Generative AI was used to generate pictures to illustrate the concept of repositioning cleaners during interviews.

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The Added Value of Task Shifting: FM and the Nurse Join Forces

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ABSTRACT

Background and Aim. In the Dutch healthcare sector, staff shortages coinciding with an increased care demand due to an aging population, have become a pressing issue. In many hospitals, staff work part-time, workloads and absenteeism are growing, and staff are leaving. The Dutch facility management (FM) sector faces a similar problem, caused by a growing unwillingness to perform physically demanding jobs like cleaning. FM can contribute to the solution of these developments. In this context, effects of task shifting for FM in healthcare were studied in a field experiment.

Methods and Data. In a field experiment, we examined how the transfer of non-core healthcare-related tasks from nursing to service employees was perceived by nurses (N=108) and service employees (N=57), through questionnaires in a Dutch hospital.

Results. Shifting non-core healthcare-related tasks to service employees had a positive effect on nurse's and service employee's work experience.

Originality. This study demonstrated that task shifting from nursing to FM can contribute to experiences of both nurses and service employees.

Practical and Societal Implications. This study showed that better alignment between tasks of FM and healthcare professionals can contribute to staff shortages. Service employees can support nurses by taking over basic care tasks such as feeding, washing, and performing nursing checks, while also enabling more meaningful interpersonal contact. In this way, efficiency can be increased, and the quality of care for patients and hospital staff can be improved.

KEYWORDS. cleaning, field experiment, hospitals, staff shortages, task shifting.

Type of Paper. Full Research

INTRODUCTION

In the Dutch healthcare sector, staff shortages coinciding with an increasing care demand due to an aging population have become an urgent problem. In many hospitals, staff work part-time, workloads and absenteeism are rising, and employees are leaving the workforce (e.g., Bolt, Ali, & Winterton, 2025). The Dutch facility management (FM) sector experiences a similar challenge, caused by a growing reluctance to perform physically demanding tasks such as cleaning (Weeda, 2023).

While it may seem counterintuitive, healthcare and FM can collaborate to make healthcare more future-proof. Together with other disciplines within FM, such as reception, catering, procurement, real estate, and technical maintenance, cleaning enhances the quality of life and organizational

functioning by creating a clean and welcoming environment that promotes recovery (Mobach & Bouwhuis, 2023; Zijlstra et al., 2022).

This study investigated the effects of task division in a medium-sized Dutch hospital whereby routine nursing activities were assigned to trained service employees. Service employees supported nurses by performing selected non-core healthcare-related tasks. These included cleaning of medical equipment and replacing of bedding. This approach offers a two-fold benefit: alleviating workload in the primary care processes and creating more attractive, meaningful cleaning jobs that appeal to a broader workforce demographic.

Although theoretical frameworks on task division and job crafting exist (e.g., Dutton, Debebe & Wrzesniewski, 2000), empirical research in facility management remains limited. By focusing on a real-world experiment in a hospital, this paper contributes practical insights to the field. While the findings are grounded in one specific setting, they may be transferable to other healthcare environments facing similar challenges.

LITERATURE STUDY

Task shifting

The World Health Organization (WHO) defines task shifting as “the rational redistribution of tasks among health workforce teams,” (WHO, 2008) aiming to allocate tasks to the most appropriate person. Often, this means transferring tasks from highly qualified professionals to those with fewer qualifications, to improve efficiency and resource use. However, this interpretation can be too narrow. Tasks may also be better performed by someone with different, not necessarily lower, qualifications—or even by someone at a higher employment level—depending on the skills required and the context in which the task is performed (European Commission, 2019). Schalkwyk et al. (2020) distinguish three forms of task shifting: enhancement, substitution/delegation and innovation. enhancement, which involves expanding the depth or breadth of an existing role; substitution or delegation, where tasks are transferred to another worker or to patients or carers, often at a lower hierarchical level; and innovation, which introduces entirely new roles in response to changes such as technological developments. Many studies have examined task shifting from doctors to nurses (e.g., Laurant et al., 2005; Nicholson et al., 2013), from doctors to pharmacists (e.g., Dawoud et al., 2018), and from nurses to patients (e.g., Kaptein et al., 2014), other health workers (e.g., Gilmore et al., 2013), or machines (e.g., Das et al., 2018). Remarkably, the potential role of facility management staff in task shifting is largely absent from the literature. This is notable, as delegating simple, non-core healthcare-related — such as cleaning or logistical support – from nurses to FM personnel could ease workload pressures and allow more time for patient care. The lack of attention to FM reflects a narrow and medical focus in current task shifting research.

Nurses' perspective

Nurses frequently perform non-clinical tasks - such as waste disposal, restocking supplies, and environmental cleaning - that may increase their work pressure and detract them from time spent on direct patient care. Nurses perform such tasks with good reason for a long time. In 1859, Florence Nightingale reported that hospital mortality rates dropped significantly - from 52% to 20% - after several crucial facility-related interventions were implemented, such as improving air circulation through the use of windows and roof vents and cleaning tasks like the regularly washing the hospital's walls and floors and introducing daily trash removal from the premises (Bostridge, 2009). A study of Buck et al. (2018) showed that nurses still spend considerable time performing non-nursing care tasks, which could be accomplished by other staff and/or departments. Tasks included appointment/procedure scheduling, secretarial duties (e.g., faxing), housekeeping, and meal tray retrieval/delivery to the bedside. These tasks reportedly also affected patient satisfaction/safety and well-being, so nurses felt compelled to complete when other responsible parties did not, according to Buck et al. (2018). This observation is also confirmed in other parts of healthcare. For instance, a study in long-term elderly care (Westenenk, 2024) showed that care professionals also carry out facility

tasks (3.37%, SD = 1.51%), logistical tasks (3.22%, SD = 2.39%), non-core social activities (4.44%, SD = 2.45%) - such as 'shopping with a client' - and non-core assistance with eating and drinking (3.01%, SD = 1.95%). Redistributing such facility-related duties to cleaning staff or other non-nursing personnel may offer a viable solution to reduce nursing workload. Moreover, Enggaard et al. (2024) add that involving non-nurses in the delivery of indirect nursing care may ease nurses' workloads and releases time to spend with patients. Quality of care can be improved if the competencies of these non-nurses' match patients' care needs. However, the involvement of non-nurses in direct nursing care also needs caution, because it may complicate nurses' delegation practice and cause uncertainty about their nursing role, according to Enggaard et al. (2024).

FM perspective

Emerging evidence demonstrates that hospital cleaning staff often engage in supportive interactions with patients that go beyond their formal job descriptions. For instance, a variety of studies shows that cleaners routinely engage in mental, emotional, and even spiritual support for patients, and that they like to do this. However, they also need training and support to perform better and feel more at ease in that respect, and there are ample opportunities to use these qualities to improve the situation for cleaners, patients, and healthcare in general (Ashton & Manthorpe, 2019; Jors et al., 2017; Mack et al., 2003; Messing, 1998). This observation reveals an opportunity to expand our understanding of how different staff contribute to the patient experience (Vance et al., 2022). Many cleaners exhibit a particular openness and humility that allows them to build unique relationships with patients, often offering small moments of human connection that patients deeply value, because nursing staff often lacks the time for this additional care (Jors et al., 2017). Despite these relational contributions, cleaners frequently feel undervalued and invisible within institutional hierarchies (Messing, 1998; Cross et al., 2019); this was confirmed in other sectors (Van Vlijmen, 2017). Recognition often comes only after a space is cleaned, reinforcing the notion that their worth is tied solely to cleaning rather than patient care. This dynamic is not limited to moments when the space is clean — cleaners often receive negative attention when the job is perceived as poorly done, which is typical of a dissatisfier (Dutton et al., 2016). As Ashton and Manthorpe (2019) argue, valuing only their technical tasks risks erasing their relational impact. True recognition, then, requires acknowledging their role in healing through presence, listening, and compassion (Vance et al., 2022). This may be seen as an opportunity to enrich cleaning roles, while being mindful of the boundaries with clinical care.

METHODS AND DATA

Procedure

Data were collected in a nursing ward of a Dutch hospital. The study consisted of a control and experimental condition. In the experimental condition, non-core healthcare-related tasks were reallocated from nurses to facility management (FM) service employees, aiming to reduce the workload of nursing staff. These tasks consisted of room cleaning, area tidying, aid searching, bed making, supply restocking, and patient transport. The tasks were determined in a workshop with nurses and service employees which was a joint effort of service provider and hospital. These tasks were expected to be effective and feasible. Effective in lowering the workload for nurses, and feasible given the interest at both nurses and service employees, and the explorative nature of this experiment: a task shift without further training. The study used a quasi-experimental design on a single nursing ward. In the control condition (April 2021), data were collected before the intervention, reflecting the standard division of tasks between nurses and service employees. In the experimental condition (December 2021), data were collected after the introduction of a new task division, where selected non-core healthcare tasks were shifted from nurses a small, designated group of FM service employees, assigned specifically to support the nursing team.

Participants

In the experimental condition, 65 nurses and 7 service employees participated, while the control condition included 52 nurses and 50 service employees. All nurses present during the respective data

collection periods completed the survey, making the nurse samples representative of the ward population. In the control condition, all 50 service employees were invited, whereas in the experimental condition only the 7 service employees who were selected and trained for the intervention were surveyed. This reflects a deliberate design choice and explains the smaller sample. While the total sample is representative of the staff involved, the small number of service employees in the experimental condition calls for cautious interpretation of their results.

Measures

The same questionnaire was used in the experimental and control conditions. The questionnaire for nurses consisted of items that evaluated the frequency and required minutes for performing various tasks, also items were included that evaluated their perception of their work (Appendix A Table 1). The questionnaire for service employees consisted of items evaluating job satisfaction, task diversity, the ability to care for patients and support nursing staff (Appendix A Table 2). To compare the results of nurses and service employees, three items were identical: job satisfaction, task diversity and collaboration with the nurse or service employee.

RESULTS

This section presents the results from nurses' and service employees' perspectives, focusing on task frequency, daily time spent, and satisfaction levels in the experimental and control conditions. Independent samples t-tests were conducted to examine the differences between conditions.

Nurses' perspective

Table 1 presents the frequencies of the different tasks carried out by nurses in the experimental and control conditions. An independent samples t-test was performed with the condition (experimental or control) as the independent variable and the different tasks as dependent variables. The shift of care tasks to service staff resulted in perceptions of a reduced task frequency for nurses in room cleaning ($t(114) = 6.40$, $p < .001$, $d = 1.19$), area tidying ($t(114) = 5.30$, $p < .001$, $d = 0.99$), aid searching ($t(115) = 6.34$, $p < .001$, $d = 1.18$), bed making ($t(114) = 6.54$, $p < .001$, $d = 1.22$), supply restocking ($t(115) = 6.14$, $p < .001$, $d = 1.14$), and patient transport ($t(115) = 2.54$, $p = .012$, $d = 0.47$).

Table 1 Mean values and frequencies reported by nurses for different tasks carried out in the experimental condition (EC) and control condition (CC)

Tasks	M		Task frequency									
			Never		Monthly		Weekly		Daily		Multiple times per day	
	EC*	CC*	EC	CC	EC	CC	EC	CC	EC	CC	EC	CC
Room cleaning	2.30	3.65	23	4	11	4	18	8	12	26	0	10
Area tidying	3.19	4.17	8	0	12	0	10	6	28	31	6	15
Aid searching	2.37	3.81	25	2	13	3	9	12	14	21	14	14
Bed making	2.59	3.87	15	2	11	4	23	4	15	31	0	11
Supply restocking	1.91	3.19	34	6	12	6	12	15	5	22	2	3
Patient transport	3.29	3.77	4	0	11	4	22	14	18	24	10	10

Note. *1 = never, 2 = monthly, 3 = weekly, 4 = daily, 5 = multiple times per day.

Table 2 presents the daily time spent on different tasks carried out by nurses in the experimental- and control condition. An independent samples t-test was performed with the condition (experimental or control) as independent variable and the different tasks as dependent variables. The shift of care tasks to service staff resulted in perceptions of a reduced daily time spent for nurses on room cleaning ($t(97) = 6.998$, $p < .001$, $d = 1.42$), area tidying ($t(99) = 5.693$, $p < .001$, $d = 1.14$), aid searching ($t(99) = 5.264$, $p < .001$, $d = 1.06$), bed making ($t(100) = 6.455$, $p < .001$, $d = 1.29$) and supply restocking ($t(99) = 4.958$, $p < .001$, $d = 0.99$), and patient transport ($t(97) = 2.162$, $p < .05$, $d = 0.44$).

Table 2 Mean values and standard deviations of the reported daily time spent by nurses on tasks carried out in the experimental condition (EC) and control condition (CC)

Tasks	Experimental condition M (SD)*	Control condition M (SD)*
Room cleaning	7.50 (7.05)	24.4 (16.25)
Area tidying	12.98 (12.26)	29.0 (16.10)
Aid searching	6.79 (7.76)	15.9 (9.70)
Bed making	7.58 (6.88)	18.2 (9.79)
Supply restocking	2.88 (5.70)	10.7 (10.05)
Patient transport	18.45 (13.81)	25.1 (16.63)

Note. *Values represent minutes per workday.

Table 3 presents the reported satisfaction levels across different aspects, as assessed in the experimental- and control condition. An independent samples t-test was conducted with the (experimental or control) condition as the independent variable and the various satisfaction items as dependent variables. The shift of care tasks to service staff resulted in a significant difference in satisfaction with nursing care ($t(106) = -2.880$, $p = .005$, $d = -0.56$) and service staff collaboration ($t(105) = -2.237$, $p = .027$, $d = -0.44$). However, no significant differences were observed for task variety ($t(106) = -0.581$, $p = 0.562$, $d = -0.11$) or general satisfaction ($t(106) = 1.135$, $p = 0.259$, $d = 0.22$).

Table 3 Mean values and standard deviations for the different dimensions of satisfaction reported by the nurses in the experimental condition (EC) and control condition (CC)

Tasks	Experimental condition M (SD)*	Control condition M (SD)*
Task variety	7.92 (1.24)	7.79 (1.041)
Nursing care time	7.80 (1.15)	7.13 (1.279)
Service staff collaboration	7.97 (1.52)	7.30 (1.518)
General satisfaction	7.92 (1.16)	8.15 (0.884)

Note. *Scores based on a 10-point scale (1 = unacceptable, 10 = excellent).

FM perspective

Table 4 presents the reported satisfaction levels across different aspects, as assessed in the experimental condition (EC) and control condition (CC) for service employees. An independent samples t-test was conducted with the condition (experimental or control) as the independent variable and the various satisfaction items as dependent variables. The shift of care tasks to service staff resulted in significant differences in satisfaction with nursing care ($t(54) = -2.581$, $p = .013$, $d = -1.04$) and nursing support ($t(54) = -2.041$, $p = .046$, $d = -0.83$). However, no significant differences were found for nursing collaboration ($t(53) = -0.961$, $p = .341$, $d = -0.39$) or general satisfaction ($t(54) = -0.490$, $p = .626$, $d = -0.20$).

It is important to note that the results should be interpreted with caution due to the small sample size in the experimental condition. This limitation may affect the generalizability and statistical power of the findings which will be further discussed in the discussion section.

Table 4 Mean values and standard deviations for the different dimensions of satisfaction reported by the service employees in the experimental condition (EC) and control condition (CC)

Items	Experimental M (SD)*	Experimental n	Control M (SD)*	Control n
Patient care	9.00 (0.81)	7	7.61 (1.38)	49
Nursing support	8.43 (0.53)	7	7.49 (1.19)	49
Nursing collaboration	8.14 (0.37)	7	7.67 (1.29)	48
General satisfaction	8.57 (0.53)	7	8.33 (1.30)	49

Note. *Scores based on a 10-point scale (1 = unacceptable, 10 = excellent).

DISCUSSION

This study examined the effects of task redistribution from nurses to service employees in a healthcare setting. The intervention, which involved shifting non-core care tasks (e.g., cleaning, bed making, restocking), led to measurable reductions in perceived task frequency and time investment among nurses. It is important to clarify that this study focused on the immediate operational outcomes of

reassigning specific tasks and did not investigate broader organizational changes, such as role redesign, team structures, or integrated workflows. Therefore, conclusions should be limited to the direct effects of task shifting, and any interpretations beyond that should be considered exploratory and a potential avenue for future research. Our findings are in line with earlier studies on this topic. The reductions in frequency and time spent on non-core healthcare tasks by nurses align with Buck et al. (2018) observations that nurses perform tasks that can be done by other departments. The improvement of service employees' satisfaction with patient care opportunities supports Jors et al. (2017) finding that cleaners often desire deeper engagement with patients.

The significant reduction in task frequency and time for nurses on non-core activities suggests that task reallocation was operationally successful. Particularly, the large effect sizes for tasks such as room cleaning ($d = 1.42$) and bed making ($d = 1.29$) indicate a substantial practical impact, implying that nurses were effectively relieved from time-consuming, low-complexity tasks.

Interestingly, while general satisfaction did not differ significantly between conditions, satisfaction with nursing care time and collaboration with service staff did improve. This suggests that while overall job satisfaction may be influenced by many factors, task relief and better teamwork are important contributors to perceived improvements. The absence of significant change in satisfaction with task variety could indicate that the remaining nursing tasks still offer sufficient diversity, or that this aspect is less sensitive to changes in task allocation.

The results for service employees, though promising, must be viewed with caution due to the small sample size. However, the large effect sizes on perceived patient care opportunities ($d = 1.04$) and nursing support ($d = 0.83$) hint at meaningful improvements in perceived role value and team integration. These findings suggest that service employees can experience an enhanced sense of purpose when they are more actively involved in the care environment, echoing earlier work by Jors et al. (2017).

Although patient perceptions were not the primary focus of this study, we expect task shifting to have positive downstream effects on how patients experience care. This is in line with Vance et al. (2022) and Vos et al., (2019), who emphasize the role of cleaners in providing meaningful human connection. Formalizing and supporting these interpersonal roles within task shifting could enhance patients' sense of comfort and connectedness, while also allowing nurses to focus on specialized care tasks. Further research into how task shifting influences patient-perceived care quality would be a valuable addition to this field. Future research should measure actual work performance combined with self-reported data, for example through structured observations and time motion studies (e.g., Mobach, 2006, 2008; Westenenk, 2024). Such studies will provide valuable insights into actual performance which will allow for evidence-based decision-making in practice. In addition, future research could explore broader organizational aspects of task shifting, such as the impact of role redesign, team structures, and integrated workflows on care quality and employee experience.

Lastly, while the intervention focused on clearly delineated, non-clinical support tasks, we acknowledge that the scope of tasks that FM personnel can take on in care environments is necessarily limited by professional boundaries and training requirements. Task shifting should always respect these boundaries, and our study does not suggest that FM staff should replace or replicate nursing expertise. Instead, it highlights how reallocation of routine support tasks may contribute to more effective use of nursing capacity. Future research could further explore how such redistribution can be implemented safely and responsibly in different organisational contexts.

Despite promising results, the limited sample size of service employees in the experimental condition ($n=7$) calls for careful interpretation of results and for larger scale studies to replicate our findings. Due to the limited number of service employees involved in the intervention ($n = 7$), the sample size was small, although a full response rate of 100% was achieved. Future studies may want to include more service employees in an experimental condition.

CONCLUSIONS

This study showed that improved alignment in task allocation between nurses and service employees can have positive operational and perceptual effects. While we refer to the intervention as a form of task shifting, the study primarily investigated the effects of task redistribution on time use and satisfaction. Future studies could explore how more comprehensive forms of task redistribution — including training, communication, and team-based collaboration — impact both service quality and staff experiences.

This research provides empirical evidence of the expanding role of FM professionals in healthcare. It highlights how FM staff can support clinical operations, enhance collaboration, and improve employee satisfaction, broadening the understanding of FM's contribution in healthcare and encouraging further study of workforce integration and role development.

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APPENDIX A

Table A1 Overview of questionnaire items and answer types presented to nurses

Item	Label	Answer type
How often do you perform the following tasks?	Task frequency	
Cleaning patient rooms and equipment	Room cleaning	Fivepoint scale*
Tidying up patient rooms and equipment	Area tidying	Fivepoint scale*
Searching for medical aids	Aid searching	Fivepoint scale*
Making beds	Bed making	Fivepoint scale*
Restocking materials	Supply restocking	Fivepoint scale*
Transporting patients (ER / OR / Examinations)	Patient transport	Fivepoint scale*
* (1) never, (2) monthly, (3) weekly, (4) daily, (5) multiple times per day		
How much time do you spend on average per workday on these tasks?	Daily time spent	
Cleaning patient rooms and equipment	Room cleaning	Minutes
Tidying up patient rooms and the department	Area tidying	Minutes
Searching for medical aids	Aid searching	Minutes
Making beds	Bed making	Minutes
Restocking materials	Supply restocking	Minutes
Transporting patients (ER / OR / Examinations)	Patient transport	Minutes
How often do you experience difficulty performing the following tasks due to lack of time?	Time constraints	
Quality registration/intake and other indicators	Quality registration	Fivepoint scale*
Guiding the admission process and preparing patients/families for discharge	Admission/discharge guidance	Fivepoint scale*
Comforting/talking to patients	Patient comfort/communication	Fivepoint scale*
Developing/updating care plans	Care plan updates	Fivepoint scale*
Personal development/mandatory training	Professional development	Fivepoint scale*
Your role as a mentor/coach (guiding students, trainees, and interns)	Mentoring role	Fivepoint scale*
Working on focus areas / participating in working groups / quality improvement	Quality improvement work	Fivepoint scale*
How satisfied are you with...	Satisfaction ratings	
The variety in your tasks?	Task variety	Tenpoint scale**
The time you can dedicate to nursing care during your work?	Nursing care time	Tenpoint scale**
The collaboration with service employees?	Service staff collaboration	Tenpoint scale**
How would you rate your current job satisfaction?	General satisfaction	Tenpoint scale**
** (1) unacceptable (2) (3) (4) (5) (6) (7) (8) (9) (10) excellent		

Table A2 Overview of questionnaire items and answer types presented to service employees

Item	Label	Answer type
How satisfied are you with...	Satisfaction ratings	
The variety in your tasks?	Task variety	Tenpoint scale**
How well you can care for patients?	Patient care	Tenpoint scale**
The extent to which you can support nursing staff?	Nursing support	Tenpoint scale**
The collaboration with the nursing staff?	Nursing collaboration	Tenpoint scale**
How would you rate your current job satisfaction?	General satisfaction	Tenpoint scale**
** (1) unacceptable (2) (3) (4) (5) (6) (7) (8) (9) (10) excellent		

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