

Effect of Personalized Environmental Control Systems on Occupants' Health, Comfort and Productivity

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SUMMARY

This summary highlights the benefits of PECS for occupants' health, comfort, and cognitive performance. A comprehensive literature review was conducted using databases such as Scopus, Web of Science, and Google Scholar, focusing on terms related to personalised conditioning, air quality, lighting, and acoustics. Relevant studies were identified and reviewed.

The session will present findings categorized into four topics: the relationship between thermal comfort and PECS performance, air quality and contaminant removal efficiency with PECS, cognitive performance and PECS, and overall health and well-being linked to PECS performance.

KEYWORDS

Indoor Environment, Personalized Environmental Control Systems (PECS), Thermal Comfort, Air Quality, Occupant Health and Performance

1 INTRODUCTION

Indoor environment influences the health, comfort, and performance of building occupants (Wargocki et al., 2006; Sundell et al., 2011; Tang et al., 2020). Centralised heating, ventilation, and air-conditioning (HVAC) systems are the primary methods for controlling indoor air quality and the thermal conditions in buildings. These systems are designed to ventilate and condition the entire room air volume and provide uniform temperature and velocity distribution in the occupied zone at levels acceptable for an 'average occupant'. However, due to factors like gender, age, fitness, and personal preferences, it has been challenging for HVAC systems to maintain indoor temperature and humidity levels that meet everyone's thermal comfort needs (Indraganti, 2010). In addition, the method of ventilating an entire room based on total volume air distribution is often not efficient in providing pollutant-free air. Efficient transport, dilution, and removal of airborne contaminants in indoor environments are defined by air distribution. However, it is challenging to control the overall airflow pattern in rooms (Melikov, 2016). To overcome these disadvantages of HVAC systems, Personalized environmental control systems (PECS) have been extensively researched for their effectiveness in improving individual thermal comfort and providing high ventilation efficiency in the breathing zone of the occupants (Melikov, 2016; Vesely, M. and Zeiler, W., 2014). PECS are systems that can provide individually controlled thermal, air quality, acoustic or luminous environments in the immediate surroundings of an occupant without directly affecting the entire space and other occupants' environment.

There are several systematic literature reviews which describe the different PECS (Rawal et al., 2020). However, most existing literature review studies have focused primarily on the effectiveness of PECS in terms of human thermal comfort and energy-saving efficiency. The current summary will focus on the benefits of PECS in terms of occupants' health, comfort and cognitive performance.

2 METHODOLOGY

The scientific databases Scopus, Web of Science, PubMed, Research Gate, Google Scholar, and Taylor and Francis were searched. A separate search was conducted for each domain. For the thermal and indoor air quality environmental domains, the search was done using the following keywords: personalised, local conditioning, heating and cooling in combination with thermal comfort/sensation, air quality, perceived air quality, cross-infection, exposure, airborne transmission, human-centred, occupant health, well-being, productivity, physiological response, human response and cognitive performance. For the visual domain, the following keywords were used: personal/personalized light, personalised façade, personalised shading/solar control/control in combination with human-centric, individual control, integrated/spectral/health lighting, and visual comfort. To search for relevant literature related to Acoustic PECS, the following keywords were used: personalized audio/sound, sound mask, noise mask in combination with headphones, earphones, headset, earmuff, earplug, and sound zone. Additionally, the keywords individual control, build environment, office, workplace, school, and home were used in the search strings for all domains. The resulting articles' abstracts were subsequently examined to ensure they aligned with the paper's objectives. After this step, the relevant papers were identified and reviewed.

3 RESULTS

During the workshop on Advancing Personalised Environmental Control Systems, this session will present results based on the existing literature grouped into four topics:

- Link Thermal Sensation/Acceptability/Comfort votes/ with PECS performance and Background environment
- Link Perceived Air Quality votes/Contaminant removal efficiency with PECS performance and Background environment
- Link Performance/Cognition/Psychological tests with PECS performance and Background environment
- Link Health/Well-being with PECS performance and Background environment

4 ACKNOWLEDGEMENTS

This work was conducted within the framework of IEA-EBC Annex 87.

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