



The mediation effect of employee's wellbeing of occupants in LEED certified and non-certified office buildings in Bangkok on IEQ and its impacts on employee's performances

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Article Info

Article history:

Received 09 October 2024

Revised 02 February 2025

Accepted 19 February 2025

Available online 01 September 2026

Keywords:

employee's wellbeing,
green buildings,
Indoor Environmental Quality (IEQ),
productivity,
sustainable development

Abstract

This study provides a comparison of the occupant and organizational benefits between LEED certified and NON-LEED certified office buildings located in Bangkok. This study examined the relationship among occupants' satisfaction toward indoor environment quality (IEQ), the employees' wellbeing, performance, engagement and their organizational commitment. Structural Equation Model (SEM) is used to analyze the relationship among the variables. The results showed that the satisfaction with the IEQ has a significant impact on employee's wellbeing and their performance for both certified and NON-LEED certified buildings. The effects are stronger in LEED certified buildings than NON-LEED certified buildings. Importantly, this study showed evidence that the employee well-being is a mediator between IEQ satisfaction and employee's performances, engagement and commitment. The evidence from this study can prove that a better IEQ in sustainable office buildings can increase the employee's performance. Moreover, working in sustainable buildings can enhance the better work environment for occupants, which leads to better employee well-being. Implications were discussed for a healthy workplace for an organization and escalating the number of sustainable developments in Thailand.

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Introduction

Sustainability is not a new concern for the real estate sector in Thailand; however, there have been only few

adoptions of green building practices since 1990 (Chong, 2013). In 1997, Environmental Impact Assessment (EIA) was issued to assess the new developments. EIA has an objective to reduce the environmental problems

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along the construction period and after the project completion. The Minister of Energy issued the Green Building Energy Code (GBEC) in 2009 to promote the energy consumption standards for large buildings. The Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, started to enforce the most recent efficiency standards on newly construct projects in 2017, which aimed to monitor the energy consumption of large buildings in Thailand. There are various types of sustainable certification and standard that are attractive to the investors/developers and corporate occupiers/tenants in terms of value-added to the property and businesses. Those certifications/standards are assessed for both new construction and existing projects. By having the sustainable certifications, the investors/developers can ensure the rent premium and guarantee of energy efficiency (Cajias & Piasolo, 2013; Häkkinen & Belloni, 2011). There are many popular sustainable building certifications globally. Among the many certifications, Leadership in Energy and Environmental Design Certification or LEED Certification is the most popular international certification in Thailand. The certification will be given to the projects that satisfy the sustainable practices and criteria. Thailand's commercial property consumes over 30 percent of all the energy consumption and releases an enormous quantity of CO₂ emission and GHG (Greenhouse Gas) emission (Sugsaisakon & Kittipongvises, 2021) especially in Bangkok, where the biggest business district is located clustered with many high-rise buildings that consume large amounts of energy and releases huge emissions. To reduce the number of emissions released into the atmosphere, the introduction of sustainable development is needed since such consumes less energy and pollutes less than conventional construction. However, there are few studies that investigate this issue and no comparative study. Therefore, this study aims to understand the effects of sustainable office buildings that have carried LEED certification in Bangkok compared those benefits with non-LEED certified buildings. The objective of this study is to investigate and compare the benefits (i.e., employee's performance, employee's workplace well-being, work engagement and organizational commitment) among LEED certified, and non-LEED certified office buildings located in Bangkok and compare those benefits with non-certified buildings. The previous studies are discussed in the next section. Then, the hypotheses are proposed, and research results presented in the following sections.

Literature Review

Sustainability is a broad concept that is used by many industries from consumer products to the real estate product. In ecology, the meaning of sustainable describes the production of any plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare without compromising future generations' ability to do the same. Criteria of sustainable building cover a wide range of characteristics.

A sustainable building should be one which meets peoples' needs – as a home, or a workplace for example – in ways which enhance its positive impacts and minimize its negative impacts, environmentally and socially, both locally and globally over time.

Sustainable Measurement/Certification

There are several sustainable certifications available globally. The introduction to the sustainable certification started with BREEAM in 1990. BREEAM is a first sustainable rating system developed by Building Research Establishment in United Kingdom. The most widely used sustainability rating system for the property is LEED. LEED certification is a globally recognized symbol of sustainability achievement and leadership. LEED Certification is given to the property which satisfies the sustainable practices and criteria from U.S. Green Building Council. A LEED-certified building uses less energy and water, avoiding waste, saving on maintenance costs, improving indoor air quality, offering comfort to the occupants, and creating less environmental burden on the community. They also know that they are in a building that enhances health and wellness. In total, LEED has certified more than 100,000 projects worldwide. In Thailand, there is TREES standard. This standard was developed by two organizations, namely, Thai Green Building Institute (TGBI) from the cooperation of the association of Siamese Architects under Royal Patronage (ASA), and The Engineering Institute of Thailand under H.M. the King's Patronage. The TREES rating system is quite similar to LEED rating system. Those auditing and rating systems also share the common criteria and certification levels. In total, TREES has certified more than 193 projects in Thailand.

Lohmeng et al. (2017) studied the important key categories from different rating systems and they found that all of them have the same objectives which aim to create energy efficiency and healthy environment with

the least energy and resources. While LEED proposed 9 indicators of sustainable building including integrative process, location and transportation, sustainable site, water efficiency, energy and atmosphere, material and resources IEQ, innovation and regional priority, TREES shared 8 common indicators with LEED except for the Regional Priority.

Sustainable Buildings in Thailand

There are few case studies from Thailand on sustainable buildings. Shen et al. (2018) studied the capabilities and barriers of green technical on green buildings from the architects, engineers and consultants' perspectives. The top capabilities are rating system and skilled in energy system for the project's stakeholders while the barriers are from financial concerns, limited technology, and unsupportive promotion from the government. The lack of motivation and high cost of construction are the top barriers for the investors/developers.

In another study from Shen et al. (2017), they studied the success factors of green buildings with LEED and TREES certification in Thailand from the perspectives of green buildings projects' stakeholders. The critical success factors of green buildings in Thailand are based on the competence of individual participants and integration of a project team during the development process, and economic conditions from both global and local levels, which can create the demand and supply of new green buildings. The main key drivers for the building owners or developers to obtain LEED certifications are environmental concerns, corporate social responsibility purposes and marketing strategy.

Santhitham and Horayangkura (2017) studied the social benefits of LEED-certified buildings in Bangkok. They studied four benefits which were the promotion of corporate social responsibility (CSR), corporate image and marketing, higher employee productivity, higher quality of life and less sick building syndrome. The results from 19 respondents of 3 LEED certified buildings showed that the social benefit that derived from LEED office building was to promote CSR, corporate image and marketing while the other variables have no significant effect.

Benefits of Sustainable Building to the Stakeholders

Dixon et al. (2014) studied the sustainable commercial property performances (property value and rent) in the Australian property market. They found the impact of

green certification on the property value which got the 5-star rating from National Australian Built Environment Rating Scheme (NABERS). The value of the sustainable office building is 11.8 percent higher than conventional office buildings. This result is similar to many previous papers from across countries where the price premium of sustainable office buildings with sustainable certificates are higher when compared with the conventional one (Eichholtz et al., 2009; Eichholtz et al., 2011; Fuerst & McAllister, 2011; Ghosh & Petrova, 2024; Onishi et al., 2021).

Sustainability labels increase the ability to gain rental premium for an office building. Chegut et al. (2014) investigated the financial performances of BREEM certified commercial buildings the UK property market and found the significant positive relationship between sustainable certification and the rent premium. The buildings that were BREEM-certified have 28 percent higher rental premium when compared with non-certified buildings. There was a negative relationship between energy consumption and the property yields and a positive relationship between energy conservation and market rent. For an increase in energy conservation of one percent, the rent value increased by 0.08 percent (Cajias & Piazolo, 2013).

The physical environment in an office can directly influence the employee's work performance and productivity; the increase in occupant productivity, workplace and job satisfaction through the better indoor environment. Hence, the physical office environment can enhance the level of interaction and communication among employees, which results in higher level of work performance. One of the sustainable attributes that has been evaluated by the sustainable rating system is IEQ or Indoor Environment Quality. Employee's concentration can be affected by an unpleasant IEQ. Jensen and van der Voordt (2019) identified the important factors for the healthy workplace. They found that to increase the employees' satisfaction and perceived productivity, the sustainable office workplace and its interiors are one of the important factors to increase the organizational performance.

IEQ and Employee's Performance

Occupant satisfaction refers to the level of contentment and comfort experienced by individuals (occupants) in a building or indoor environment. There are main criteria that influence the building's occupant satisfaction (Wilkinson et al., 2011). First is thermal comfort and air quality; too hot or too cold a

temperature can impact the occupant's satisfaction over the workplace (Ali et al., 2015; Feige et al., 2013; Lan et al., 2011; Park et al., 2019). Second, there is a positive relationship between the aesthetic and well-equipped facilities and the occupant's satisfaction. Thirdly, the degree of personal control over the indoor environmental conditions has positive impact on occupant satisfaction in the office building. Next is lighting and acoustics; bad acoustics create indoor noise and interrupt the employees' concentration while insufficient lighting creates dry eyes, eye irritation, and fatigue (Altomonte et al., 2017). These factors cause lower work performance for the employees. Lastly, the degree of flexibility of the space has a positive relationship with the occupant satisfaction.

The IEQ is the key criteria for productivity level of occupants in sustainable offices (Al Horr et al., 2016). In Taiwan, the IEQ criteria included the evaluation of acoustics, lighting, ventilation and decoration in the building. The comparison study of occupant's satisfaction of IEQ between sustainable buildings and conventional buildings reveals the statistically significant difference in level of occupant satisfaction. The occupants in sustainable-certified buildings were more satisfied with the IEQ than the occupants from non-certified buildings (Liang et al., 2014). In Thailand, there were few studies on the relationship between sustainable attributes and employees job satisfaction.

Employees are the most critical asset of an organization; therefore, investing in sustainable office spaces or buildings is a strategic and beneficial decision. The productivity levels of employees are greatly influenced by their physical environmental comfort and overall workplace satisfaction. The relationship between the workplace environment and employee's productivity has been heavily studied (Jensen & van der Voordt, 2019; Kato et al., 2009; Livingstone & Ferm, 2017). Many scholars studied the impact of sustainable attributes of office buildings and indoor environments on the employee productivity and occupant workplace well-being. Kamarulzaman et al. (2011) suggested that design of working space, indoor temperature, color, noise and interior plants influenced the employee's productivity. To retain the number of engaged employees, the organizations should invest in a good workplace environment that would lead to favorable outcomes. Workplace environment is one of antecedents for employee engagement in the corporate organization. Kumar and Sia (2012) found the significant positive relationship between workplace environment and the level of cognitive engagement, emotional engagement and physical engagement.

Workplace well-being refers to the subjective psychological factors that could affect an individual's health and quality of life. Employee workplace well-being is described as the worker's quality of his/her working life that affects the health (Schulte et al., 2015). The workplace is one of the factors that create better employee workplace well-being. The different physical environments create different impacts on the occupants of each building. The employee well-being and comfort in the office have significant direct effects on employee's performance (Liu et al., 2023). From the longitudinal study from Thatcher and Milner (2014), the psychological and physical workplace well-being of employees were significantly higher for the employees who worked in sustainable buildings. Similarly, Ornetzeder et al. (2016) also found that the employees in sustainable buildings in Austria were healthier than employees who worked in conventional buildings. Interestingly, Choi et al. (2023) identified unknown mediating variables between IEQ and task performance. Their study showed that IEQ has no direct effect on the employee's performance but has an indirect effect mediated by physiological response change in the body. Hence, the better well-being of employees mediated their performances.

Organizational commitment can be defined as an employee's attitude on getting attached to the company or organization where she/he is working (Meyer et al., 1989). The stronger commitment, the lower turnover intention. The physical environment in the workplace enhances the organizational commitment through job satisfaction. Such is supported in the study by Hanaysha (2016), which showed the significant positive effect of workplace environment on organizational commitment.

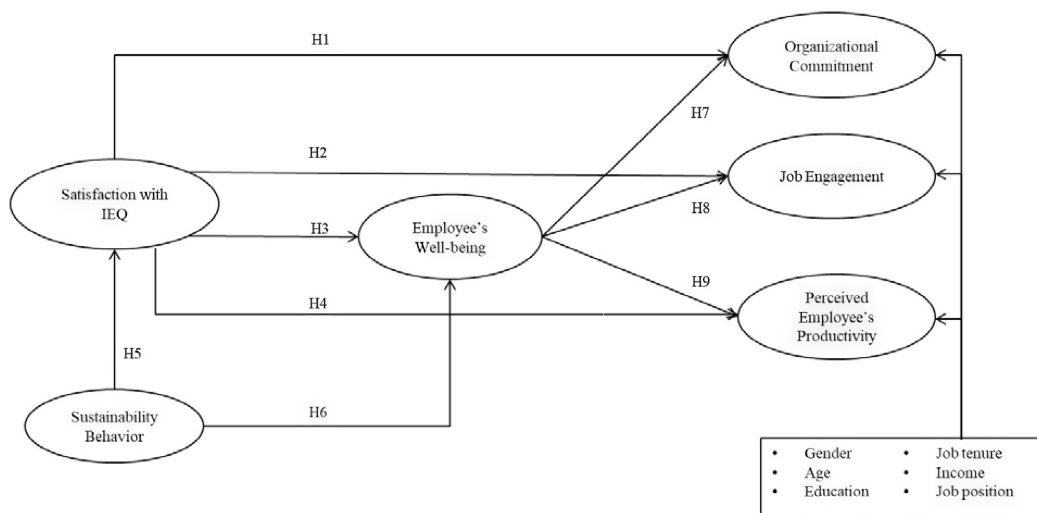
From the review of existing studies, the satisfaction with indoor environmental quality is used to investigate the determinants employee performance and organizational commitment. However, there is limited research on the mediating role of well-being in the relationship between IEQ and both employee performances and organizational commitment. Therefore, this study proposes the following hypotheses shown in [Figure 1](#) and [Table 1](#).

Methodology

The sampling frame for the sample from the LEED certified buildings was from the data provided by the U.S. Green Building Council, which is LEED assessor. The buildings are selected by the location in Bangkok and graded as grade-A office buildings the same as the non-certified buildings, which are located in the same

Table 1 Hypotheses

Hypotheses	
H1	The satisfaction with IEQ of occupants is positively related to organizational commitment.
H2	The satisfaction with IEQ of occupants is positively related to job engagement.
H3	The satisfaction with IEQ of occupants is positively related to workplace well-being.
H4	The satisfaction with IEQ of occupants is positively related to perceived employee productivity.
H5	Sustainability behavior is positively related to the IEQ satisfaction.
H6	Sustainable behavior is positively related to employee workplace well-being.
H7	Occupants who have higher employee workplace well-being level are more likely to commit to their organizations.
H8	Occupants who have higher employee workplace well-being level are more likely to engage in their job.
H9	Occupants who have higher employee workplace well-being level are more likely to be perceive for higher employee productivity level.

**Figure 1** Proposed model

location and have the same grade but without the LEED certification. The respondents are the employees from junior and senior levels who work in both non-certified office buildings and the LEED certified office buildings. The sample size is estimated to be 200 respondents for LEED certified buildings and another 200 respondents for non-certified office buildings located in Bangkok.

Data Collection

A self-administered questionnaire survey was used to collect the data for this study. A structured questionnaire is given to a sample of a population and designed to elicit specific information from respondents (Malhotra, 2007). The questionnaires were distributed to the respondents through the online channel. The data collection process, the questionnaire and the cover letter asking for cooperation were mailed to the property manager of selected office buildings. Convenient sampling and

snowball sampling which were used in this study are commonly used in the study of customers' satisfaction. Once the occupants in each building get the questionnaire, they can share with colleagues and acquaintances, which may infringe on privacy or confidentiality. However, the participants can stop answering the questionnaire if they feel uncomfortable as it is clearly stated in the questionnaire's instructions.

Questionnaire Development

The measurements were tested for reliability and validity from other scholars. All the measurement items used in this study were written in English and translated to Thai for the convenience of respondents. All the items were rated on a five-point Likert scale that ranges from 1 (dissatisfied) to 5 (satisfied). And the reliability and validity were tested by the previous scholars. In this study, the first 50 surveys were launched for the pre-

test. After the reliability and validity of pre-test were tested, the second batch of surveys were launched to the respondents.

Control variables

The control variables related to the Bangkok office building's occupants were included in the analysis, including age, gender, income, job positions, and job tenure. These variables were also taken into account in various studies (Choi, 2016; Eleswed and Mohammed, 2013; Khim, 2016; Krettenauer, 2017) in sustainable workplace and employee's performance areas.

Analysis Method

Structural Equation Model (SEM) is adopted in this study; it can be measured with the study's model to test the significance of the structural pathway and hypotheses. A structural model is used to test the ability of different constructs among the indicators of the study data. SEM is the dominant analytical tool for testing cause-effect-relationship models with latent variables (Hair et al., 2014). There are many existing studies in the field of IEQ satisfaction that adopt SEM in their research (Abdul et al., 2017; Liu et al., 2023; Nimlyat, 2018; Tekce et al., 2020). Therefore, SPSS version 23 was used to perform the statistical analysis and AMOS (Analysis of Moment Structure) version 24 was used to perform SEM regression in this study. After the confirmatory factor analysis (CFA) was conducted, the structural model meets the acceptable threshold levels (Hu & Bentler, 1999).

Results

LEED Certified Buildings

This study examined the relationship between the satisfactions upon the IEQ and occupants' work performances and workplace well-being in office buildings with LEED certification located in Bangkok. The main model calculated the variables' significant relationship through the standardized regression weight and t -value. The relationship among variables considered to be significant at significant level is when $p < .001$. The results of all hypotheses are shown in Figure 2. The satisfaction with IEQ of occupants does not influence organizational commitment ($\beta = -0.029$, t -value = -0.603). The satisfaction with IEQ of occupants is positively related to their job engagement ($\beta = 0.261$, t -value = 6.814). The occupants' satisfaction upon IEQ is positively related to workplace well-being ($\beta = 0.325$, t -value = 6.323). The occupants' satisfaction upon IEQ is positively related to perceived employee productivity ($\beta = 0.276$, t -value = 6.507). Sustainability behavior is positively related to the IEQ satisfaction ($\beta = 0.412$, t -value = 7.985). Sustainability behavior is positively related to employee workplace well-being ($\beta = 0.365$, t -value = 6.123). Occupants who have higher employee workplace well-being level are more likely to commit to their organizations ($\beta = 1.118$, t -value = 22.033). Occupants who have higher employee workplace well-being level are more likely to engage in their job ($\beta = 0.455$, t -value = 12.522). Occupants who have higher employee workplace well-being level are more likely to

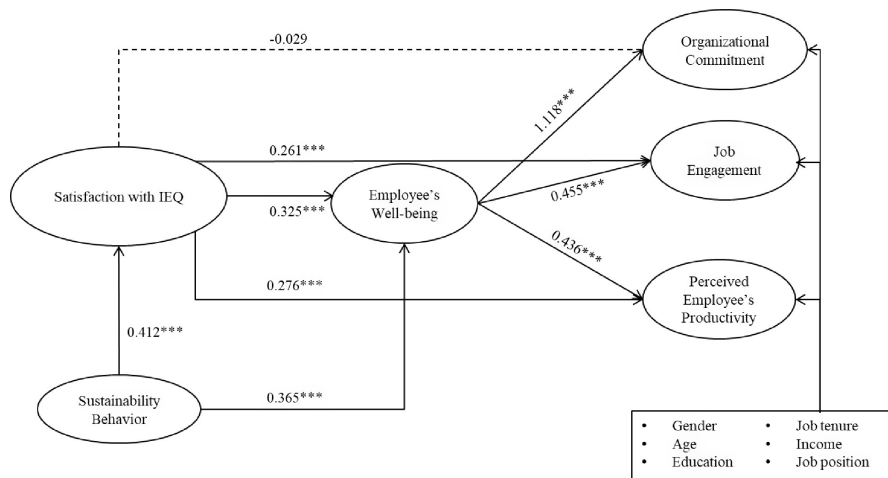


Figure 2 Results – LEED certified buildings

be perceived for higher employee productivity level ($\beta = 0.436$, t -value = 10.962).

NON-LEED Certified Buildings

This model examined the relationship between the satisfactions upon the IEQ and occupants' work performances and workplace well-being in office buildings with no LEED certification located in Bangkok. The main model calculated the variables' significant relationship through the standardized regression weight and t -value. The relationship among variables considered to be significant at significant level is when $p < .001$. The results of all hypotheses are shown in Figure 3. The satisfaction with IEQ of occupants influences organizational commitment ($\beta = 0.152$, t -value = 4.940). The satisfaction with IEQ of occupants is positively related to their job engagement ($\beta = 0.094$, t -value = 3.586). The occupants' satisfaction upon IEQ is positively related to workplace well-being ($\beta = 0.171$, t -value = 5.339). The occupants' satisfaction upon IEQ is positively related to perceived employee productivity ($\beta = 0.173$, t -value = 6.603). Sustainability behavior is positively related to the IEQ satisfaction ($\beta = 0.693$, t -value = 12.777). Sustainable behavior is positively related to employee workplace well-being ($\beta = 0.443$, t -value = 9.910). Occupants who have higher employee workplace well-being level are more likely to commit to their organizations ($\beta = 0.891$, t -value = 19.149). Occupants who have higher employee workplace well-being level are more likely to engage to their job ($\beta = 0.641$, t -value = 16.557). Occupants who have higher

employee workplace well-being level are more likely to be perceived for higher employee productivity level ($\beta = 0.631$, t -value = 16.353).

Comparison of the Results

Hypothesis 1 shows that the satisfaction of occupants upon the IEQ is related to organizational commitment. In LEED certified office buildings, this hypothesis rejected by the insignificant p -value (p -value = .546 > .50). The results are in line with Gou et al. (2012), who found that occupants in green buildings in Hongkong have less lighting satisfaction than in conventional buildings. The results found that there were weaknesses in IEQ of green buildings; the employees have significantly less satisfaction in comfort, acoustics and lighting in green buildings than the conventional buildings. While one of the antecedents of organizational commitment is workplace, hence the dissatisfaction in some IEQ attributes in green buildings can cause the differences in organizational commitment level from the employees in sustainable buildings. The study results also support the study by Thatcher and Milner (2016), which showed that there was no significant difference in the propensity to leave the organization for the occupants who work in green buildings and non-green buildings. In contrast, the result from non-LEED certified office buildings showed the relationship between occupants' satisfaction upon IEQ and organizational commitment of occupants. The result is consistent with previous studies that the satisfaction upon the indoor environmental quality in an office can enhance the employee's commitment

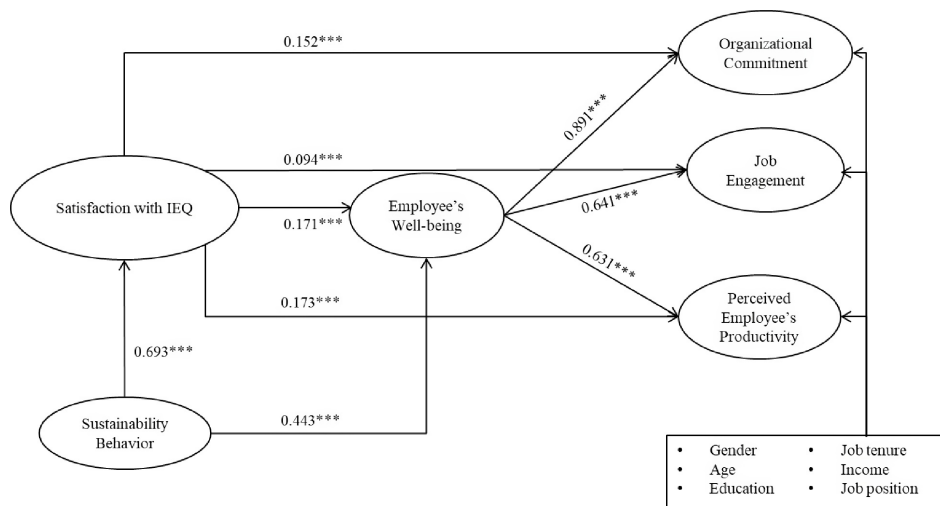


Figure 3 Results – NON-LEED certified buildings

level to the organization (Bangwal et al., 2017; Bangwal & Tiwari, 2019; Hanaysha, 2016). It also proved that occupants' satisfaction upon the environment in workplace significantly influences the level of organizational commitment of staff (Haggins, 2011; McGuire & McLaren, 2009).

Hypothesis 2 is supported by the significance of *p*-value for both groups. The satisfaction of occupants upon the Indoor Environmental Quality (IEQ) is related to the level of their job engagement. The result showed that once the occupants are satisfied with the IEQ in the offices, they tend engaged in their job. The indoor environments such as lighting, acoustics, air quality and thermal conditions affect the engagement level of the occupant. The effect of the overall indoor environment on work efficiency was reported and was consistent with many previous studies (Brown, 2009; Ukai et al., 2022).

Hypothesis 3 is supported for both models. The satisfaction upon IEQ has a significant positive impact on the occupants' workplace well-being. The occupants in both types of building tend to have a better workplace well-being when satisfied with their workplace environments. This result could be explained in that the better the indoor environment quality the better the occupant workplace well-being (Al horr et al., 2016; Bergefurt et al., 2022; Cobaleda Cordero et al., 2019; Sadick & Issa, 2017). Also, the workplace with less distraction is more suitable for occupants' mental health (Boegheim et al., 2022). Moreover, the results also supported the recent view of Parhizkar et al. (2023), where they examined the relationship between IEQ and occupants' workplace well-being from the office building in Bangkok. This study has a consistent result that the attributes of office spaces have significant impacts on human health and workplace well-being.

Hypothesis 4, the findings confirmed that the occupants' perceived productivity level is related to their satisfaction of IEQ. The results from both certified and non-certified buildings showed the significant relationship between satisfaction of IEQ and perceived productivity level. The environment in the offices enhanced the level of employee productivity in their tasks and creativities (Franke & Nadler, 2021). In addition, the office design and interior environment quality are correlated with employee's productivity (Heerwagen, 2000).

Hypothesis 5 is supported. The sustainability behavior is positively related to IEQ satisfaction. The occupants who have sustainability behaviors tend to be satisfied with their building's IEQ. The hypothesis was supported for both certified and non-certified buildings. Hill (2017) found that pro-environmental behaviors

and environmental awareness were significant factors in influencing the satisfaction of green features in the buildings.

Hypothesis 6, sustainable behavior, is positively related to employee workplace well-being. This hypothesis is supported. The occupants with sustainable behavior are more likely to perceive the better workplace well-being while they are in the building. Occupants who behave in an environmentally friendly manner would also show concern for the green features in their workplace, which have a great impact on their workplace well-being (Zhang & Tu, 2021). Hence, the occupants who have sustainable behavior tend to have better workplace well-being.

Hypothesis 7, the results showed that occupants who have higher employee workplace well-being level are more likely to commit to their organizations. The hypothesis is supported for both groups. This result also supported the previous study of Kolakowski et al. (2020) and Panaccio and Vandenberghe (2009), who found the positive relationship between employee workplace well-being and organizational commitment. Moreover, occupants who perceived better workplace well-being will commit to work with the company longer (Gardiner et al., 2013; Sears et al., 2013). The higher levels of positive mental and physical health positively impact the affective commitment level.

Hypothesis 8 is supported for both models. The occupants with higher level of employee workplace well-being are more likely to engage in their job. According to the study of Boegheim et al. (2022), occupants who have better mental health are likely to engage with their job and organization.

Hypothesis 9 is supported by the significance of *p*-value for both certified and non-certified buildings. Occupants who have higher employee workplace well-being level tend to be perceived for higher productivity level in their task. Occupants who have good workplace well-being will strongly intend to perform their tasks (Altomonte & Schiavon, 2013; Thatcher & Milner, 2014).

The comparison of the results is shown in [Table 2](#). All hypotheses are accepted, except for hypothesis 1 from LEED certified buildings, which is rejected.

After testing the direct, indirect and total effects of Employee workplace well-being, the outcomes revealed that the employee workplace well-being is mediator in this model. Additional analysis of employee workplace well-being was conducted. This analysis tested whether employee workplace well-being mediated between IEQ and organizational commitment, between IEQ and job

Table 2 Hypotheses results

Hypotheses	Results	
	LEED	NON-LEED
H1: The satisfaction with IEQ of occupants is positively related to organizational commitment.	Rejected	Supported
H2: The satisfaction with IEQ of occupants is positively related to job engagement.	Supported	Supported
H3: The satisfaction with IEQ of occupants is positively related to workplace well-being.	Supported	Supported
H4: The satisfaction with IEQ of occupants is positively related to perceived employee productivity.	Supported	Supported
H5: Sustainability behavior is positively related to the IEQ satisfaction.	Supported	Supported
H6: Sustainable behavior is positively related to employee workplace well-being.	Supported	Supported
H7: Occupants who have higher employee workplace well-being level are more likely to commit to their organizations.	Supported	Supported
H8: Occupants who have higher employee workplace well-being level are more likely to engage in their job.	Supported	Supported
H9: Occupants who have higher employee workplace well-being level are more likely to be perceived for higher employee productivity level.	Supported	Supported

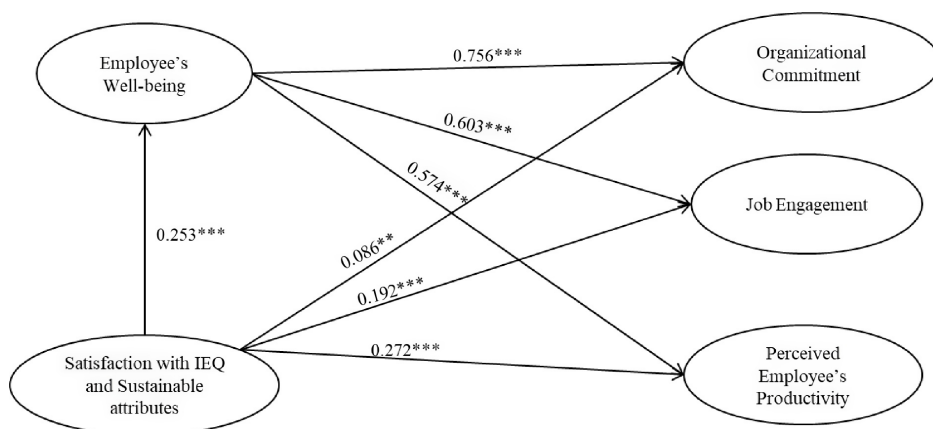
engagement, and between IEQ and perceived employee productivity. Results show that there are indirect effects of mediator through the relationships between IEQ and organizational commitment, between IEQ and job engagement, and between IEQ and perceived employee productivity. The form of mediation is partial mediation, where the direct effects between IEQ and employee workplace well-being, between IEQ and organizational commitment, between IEQ and job engagement, and between IEQ and perceived employee productivity are significant, as shown in Figure 4, and also have the significant indirect effects through the mediator which is employee workplace well-being. Moreover, the direction of direct and indirect effects is similar where it showed the positive influence. Hence, this study has a complementary mediation.

Discussion

Discussion on Impact of IEQ on Employee's Workplace Well-Being and Performance

The findings indicate that satisfaction with IEQ has a significant influence on employee well-being, organizational commitment, job engagement and productivity. These results confirm that IEQ can substantially enhance workplace well-being and employee performances among occupants.

The satisfaction toward IEQ was found to influence the job engagement, and workplace well-being level of occupants in LEED and NON-LEED office buildings. The effects are stronger in LEED certified buildings than NON-LEED certified buildings. Interestingly, the

**Figure 4** Results of direct effects, *** $p < .001$, ** $p < .01$, * $p < .05$

occupants in NON-LEED certified buildings who were satisfied with IEQ tend to have higher organizational commitment but there is no significant difference in the organizational commitment level from occupants in LEED office buildings.

This study proved that the employee workplace well-being has a strong and significantly direct impact on employee performances. The employee's workplace well-being significantly affects employee's organizational commitment in both types of buildings. The standardized path coefficient (β) of LEED certified buildings is higher than NON-LEED certified buildings. The employee workplace well-being was also found to influence the level of job engagement and perceived productivity. However, when comparing the impact of employee's workplace well-being on job engagement and perceived productivity, the impacts are stronger in NON-LEED certified buildings.

Discussion on The Influences of Sustainability Behavior upon IEQ Satisfaction and Employee's Workplace Well-Being

The sustainability behavior positively affects the satisfaction upon IEQ and employee's workplace well-being in both LEED and NON-LEED buildings. The occupants who have sustainability behavior tend to be satisfied with IEQ of their buildings. These results supported previous studies from Kaida and Kaida (2019); Zhang and Tu (2021). Furthermore, the sustainability behavior also enhances the level of employee's workplace well-being.

Conclusion and Recommendation

This study compared the benefits of IEQ between certified and non-certified buildings on the occupants who work in office buildings located in Bangkok. This research provides the following academic and practical contributions. Firstly, this research confirms the impact of IEQ on employee's workplace well-being and work performance. Next, this study found that the occupants in LEED certified buildings who are satisfied with IEQ in the buildings tend to have stronger degrees of job engagement and workplace well-being than occupants in NON-LEED certified buildings. Importantly, this research found that the workplace well-being of occupant is a mediator through the relationships between IEQ and organizational commitment, between IEQ and job engagement, and between IEQ and perceived employee

productivity. In LEED certified buildings, the occupants who are satisfied with IEQ and perceived higher level of employee workplace well-being, tend to have higher levels of job engagement and perceived higher levels of productivity. The total effect of employee's workplace well-being is higher when compared to NON-LEED certified building.

The results from this study showed that the well-being is the significant mediator that enhances the employee productivity, engagement and commitment, which are the factors in organizational improvements. Therefore, to increase the level of organizational improvements, the organizations need to focus on their employee's well-being.

The study results can be used as reference for the government decision upon the incentives to green or sustainable developments in Thailand. The proof from this study also brings valuable information to the property market, especially office space market. It is not only new construction projects that will benefit from a sustainable project, but the existing buildings will also have an incentive to retrofit their building with sustainable attributes and consequently expect higher rental price and attracting more tenants. The evidence from this study can prove that a better IEQ in sustainable office building can increase the employee's performance. Moreover, working in sustainable buildings can enhance the better work environment for occupants, which leads to better employee workplace well-being.

The limitations of this study are the type of building, list of buildings and location of the buildings. Future research can investigate the impact of IEQ on occupants' performance in other types of properties such as educational facilities where the performance of the student can be measured, and revisit the impact of IEQ and sustainability behavior on occupant's performance in the new certified office buildings. Interestingly, the future study can compare the impact of IEQ and sustainable attributes on occupants among the different certifications since there are many sustainable certifications that recently certified the green building. Furthermore, future research can examine how IEQ in hybrid work settings both in offices and remote locations affects employee well-being, productivity, and job satisfaction.

Conflict of Interest

The authors declare that there is no conflict of interest.

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