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SYSTEMATIC ASSESSMENT WITH "POE" METHOD IN OFFICE BUILDINGS CASES STUDY ON THE REDESIGN RESULTS OF OFFICE INTERIOR AFTER OCCUPIED AND OPERATED

Asep Yudi Permana
Universitas Pendidikan Indonesia, Faculty of Technology, Department of Architecture, Bandung, Indonesia

Hafiz Nurrahman
Universitas Katholik Parahyangan, Faculty of Engineering, Department of Architecture, Bandung, Indonesia

Aathira Farah Salsabilla Permana
Institut Teknologi Nasional, Faculty of Engineering, Department of Architecture, Bandung, Indonesia

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SYSTEMATIC ASSESSMENT WITH "POE" METHOD IN OFFICE BUILDINGS CASES STUDY ON THE REDESIGN RESULTS OF OFFICE INTERIOR AFTER OCCUPIED AND OPERATED

Asep Yudi Permana[1]*, Hafiz Nurrahman[2], Aathira Farah Salsabilla Permana[3]

[1]Universitas Pendidikan Indonesia, Faculty of Technology, Department of Architecture, Bandung, Indonesia
[2]Universitas Katholik Parahyangan, Faculty of Engineering, Department of Architecture, Bandung, Indonesia
[3]Institut Teknologi Nasional, Faculty of Engineering, Department of Architecture, Bandung, Indonesia

This research is motivated by the fact that an office as a forum for activities depends on the type of business being carried out, where the conditions of the office will determine the credibility and synergy of a business entity, guaranteeing the performance and productivity of its employees. This study aims to formulate an interior design concept based on Post Occupancy Evaluation with the Mixed Methods Research (MMR) approach, which emphasizes the meaning of empiric based on relevant field data. The research method used the case study method with the MMR approach in data collection and analysis. The research step was started by analyzing the physical space conditions based on the design results that were compared with standardization, then a satisfaction survey was carried out using a questionnaire that was submitted to the employees as respondents. The MMR approach is intended to ensure the level of significance of the quality of the work environment in the room, the quality of the workplace, and the performance of employees. The research object is the Haleyora Powerindo office building, Jakarta. The results of the study show that the work environment quality is high and responds positively. According to the workplace quality, satisfaction is mainly related to workspace area and quality, comfort and style of furniture, circulation, and accessibility to the work table, effectiveness and efficiency of workplace layout, ICT implementation, and HVAC and maintenance. Social space and entertainment facilities provide flexibility in interacting between officers of different divisions that were not in the previous office. Based on the results of multiple regression calculations, the in-door environment and the officer workspace quality have a significant effect on officer performance. These are 3 main factors critical in conducting systematic evaluations to obtain results from office space design. This study is expected to be a strategic reference for planning and designing a similar spatial atmosphere in different locations or cases. Further research needs to be developed in the future on the ergonomic aspect through the human-centered design approach to obtain a single guideline for office design based on post-occupancy space performance and user participation.

Key words: in-door environment quality, workspace quality, officer performance, comfort and style of furniture, circulation, social space, flexibility

INTRODUCTION

Post occupancy evaluation (POE) was conducted on the Haleyora Powerindo building after the interior was redesigned using a green concept [1][2][3][4]. This concept fulfills the certification for energy-efficient and environmental design buildings (LEED) [1][4][5][6]. Moreover, it maintains sustainable, resilient, and competitive business growth. The building's interior was redesigned to improve the company's internal and external services. In the implementation of Haleyora Powerindo, internal and external activities are inseparable from the relationship and interaction between various parties [7]. Haleyora Powerindo (HPI), as a subsidiary coordinated by State-owned enterprises [7], engaged in maintenance and electricity networks, which are the main domestic sector. The interior design of HPI building applies the concept of open-office design in supporting Good Corporate Governance (GCG) practices both in the development of prudent, accountable, as well as responsible risk and resource management.

The office, as the main supporting facility, while working, should be planned and designed into a safe and comfortable atmosphere. This activity is a concept, design, and working drawing. The office interior is an activity area or place for officers as users. Interior design is a process of realizing user needs by considering the element of space, including floors, walls, and ceilings. Therefore, designing the office interior should support user activities concerning comfort, space, and area. It is based on the furniture layout towards the circulation system for movement, as well as the application of materials and lighting.

Activities performed in the office by the officers range from creating, printing, and keeping documents, as well to efficiently serving guests and customers. According to Moekijat (2002), the flow of office work through and between parts is an essential consideration in determining the composition of physical unity [1][8][9][10]. Desmonda (2016) explained 6 factors affecting the work environment, including interior, lighting, color, air, music, and noise levels [11]. The space atmosphere affects the work

*yudi.permana@upi.edu

passion, effectiveness, and officers' productivity through the arrangement and composition of furniture based on the activities. Therefore, in designing workspaces, it is necessary to consider the workflow for each unit or division, supported by the implementation of information technology.

Interior redesign of HPI building uses a concept that promotes the understanding of work activities. The office spaces should be more flexible, dynamic, and interconnected. Moreover, they should incorporate technology and functions that are adjustable and sustainable. Information technology plays a role in improving quality, speed, and intelligence at work, as well as interconnections in activities that focus on innovation and collaboration between officers. Therefore, working individually is minimized through the use of communication technology and combining the social and work environment. There are 3 basic components applied to the redesign of the HPI building, including productivity, cost control, and well-being.

The basic concepts implemented in interior design include adaptive applications, use of bright colors and biophilic elements, activity, and zoning-based work areas, maximizing meeting rooms, and minimizing individual spaces. Technology use is regulated in the main standards for building, lighting, and ventilation system components [12][13][14]. All of them are related to the productivity level and officer performance [8].

There has been extensive research on the relationship and effects of space atmosphere on productivity. However, there are still a few in-depth studies on the effect of workplace arrangement. The workplace is only a minimum fulfillment for the job of an officer. It is not the main basis for designing space as a need to support officer productivity and work ethic.

This study is a model for future POE as a reference for all types of spatial design in HPI company buildings. The results cannot be generalized to other cases but are a reference and input for the design of HPI buildings in different locations scattered throughout the provinces in Indonesia. Also, the results are useful in designing other buildings with similar functions. This study is expected to increase POE understanding in the interior design results of office spaces, the implications of decisions, and how well the objectives are met. The research questions were proposed based on the study background and objectives. How is the indoor environment quality in the HPI building? How is the quality of the existing workplace? How does the quality of the indoor environment and workplace affect officer performance?

LITERATURE REVIEW

Post occupancy evaluation (POE)

Issues related to environmental pollution and energy consumption in recent years have attracted attention at various levels in both architectural, engineering, and construction (AEC) industries. According to Li et al., (2018) the attention of the mass media and the public in China is increasingly concerned with the concept of sustainable construction [2][3][13][15][16][17]. The POE green building concept [14][18][19] is an indispensable element to determine the overall success of the project. Li et al., (2018) further explain how the big role of the Chinese government as a stakeholder in determining the regulation of the GB POE concept [2][12][18]. In addition, managers, property companies, and NGOs also play an important role as implementers and direct supervisors, initially being passive as active appraisers.

The building and interior design processes do not end with the construction alone. The most important thing is the performance of the building after being occupied as feedback on the success of the interior design. Post Occupancy Evaluation (POE) [20][21] is a method used in assessing performance and providing credible evidence about the positive and negative aspects of interior space from the user's perspective [22][23]. The concept of building performance, as a philosophical and theoretical basis in implementing POE, includes aspects of behavior, quality, and available facilities [24][25]. The building performance concept approach uses the principles of measurement, comparison, evaluation, and feedback. It is part of a systematic approach that aims to improve the building's environmental quality. The approach includes the mechanisms variations in building construction responsively to the desired function, based on the needs of its users [25].

POE is not a new model in assessing building performance. It emerged during World War II [26][27], around 1960 in Britain and the United States [28]. The current assessment focuses on individual building types. Therefore, since that time, POE has focused on developing science, especially on building design. In the 1970s and 1980s, POE focused more on Building Performance Evaluation (BPE) and Universal Design Evaluation (UDE). Furthermore, it emphasized evaluation in a holistic and process-oriented manner. The most widely conducted case studies include hospital cases [27][29][30] [31], DHFP, (1990) as well as in cases schools [28][33][34][35].

POE is an evaluation that obtains information on a building's performance [36], and the level of user satisfaction in its operation [26][37][38]. POE is implemented after the building has been handed over and is declared ready for occupancy [39]. According to W. F. Preiser et al., (1988), it is the process of systematically and strictly evaluating a building or space design after it has been occupied for some time [2][40][41]. From an architectural perspective, POE is a systematic study of buildings [42]. It provides information for architects about design performance, as well as building owners and users [1][43]. Friedman et al., (1978) saw from the anthropological aspect that POE is an assessment of how the designed arrangement satisfies and supports human needs explicitly and implicitly, as well as its values. W. F. Preiser et al., (1988) divided the POE process into 3 parts, including indicative, inves-

tigative, and diagnostic. This division is based on differences in time, limited resources, human factors, depth, and breadth of research, as well as costs [24].

There are 3 main objectives in POE, conducted in the practice of spatial design, including objectivity, inclusiveness, and results in distribution [45]. POE is an essential topic for the building industry in providing a feedback mechanism for architects on performance as a form of successful design. This evaluation provides feedback on building performance [46], different from the architectural criticism approach that emphasizes more on aesthetic values [47].

The building industry is increasingly developing to include architectural completion, as well as a space atmosphere. The interior designer plays a vital role in creating a spacious atmosphere. Research on spatial atmosphere and user performance includes POE based on building performance over time [23], library building objects [48], officer performance [49], the object of an architect's office building in Boston, USA [6], and theatre objects [50].

The role of residents is a major factor in building energy consumption. Based on the results of research conducted by Liang, Hong, et al. (2016) in an office building in Philadelphia, the USA shows that how the building's energy consumption is based on four distinctive patterns of user presence through cluster analysis. Besides the occupant presence, to predict energy use patterns (e.g., electricity, gas, and water), user behavior (e.g., opening and closing windows, turning on and off lights) is assessed based on historical data [16].

Office room

The office is a space used for work needs [51]. It is a place to do one or more officer activities according to the business type carried out. Office conditions determine the credibility and synergy of an entity or business group. Also, it determines the guarantee of officer performance and productivity.

An office is said to be representative when it is appropriate, promotes and motivates every personnel and officers in providing their best performance for the institution or company. According to Gie, (2000), an essential factor to be considered in office design is the determination of space functions and requirements. Therefore, the plan for using costs is calculated properly [8]. In designing an office layout to support officers' activities, it is necessary to consider the size of the existing space. Arrangement and furniture layout, according to a function, provide comfort and flexibility in working and moving officers [8][52][53].

A good office space arrangement results in an adaptive and interactive atmosphere [9][54]. Therefore, communication and interaction between officers are well connected and easily accessible. The arrangement and placement of equipment and furniture components are based on the need to make it easier for officers to work. It reduces the efficiency of time, energy, and costs [8]. This results in the officers' comfort and satisfaction while working.

Space organization plays a vital role in office arrangement by facilitating easy monitoring and supervision. Visitors give the office a good image and impression, especially for public service offices. As emphasized by Gie, (2000), the benefits of proper spatial planning are energy and time efficiency, smooth work processes, efficient space use, and reduced interference from each other.

There are 4 bases in determining the office space location and atmosphere. First, a typical job such as public services should be placed in an easily accessible area and not interfere with the circulation of other divisions. Second, divisions with close relationships should be grouped. Third, administrative work units should be placed between divisions that have a working relationship for easier communication and relation. Fourth, divisions with high noise levels should be placed far away from those that require work concentration and thinking [8][51].

An efficient office space layout should be designed through the placement arrangement of equipment, fixtures, furniture, and other elements [8]. Jobs with the same nature are grouped to make it easier to solve and consider the ergonomics, as well as the flow of communication relationships between officers [55]. According to The Office Act, one of the standard requirements for office space is that officers do not fulfill it. Moreover, each room has to meet the minimum requirements for space area of 40 square feet, or around 3.7m^2 [8][52][53][55].

Quality of the work environment (QW)

The work environment is the totality of physical, psychological, and social factors as considerations in the system. In a narrow sense, the work environment is the embodiment of a physical container that affects the appearance, safety, and quality of officers' obligations. The physical work environment, both living and inanimate objects, affect officer activities. Working conditions relate to the physical environment, including the building, the room, and work equipment. It consists of the workplace, space, layout, and noise. These factors are only a few elements of the work environment.

The quality of the work environment is a result of the process or program indicated by the performance of officers. The environment guarantees work, security, and safety. As a program, the quality of the work environment is a planned activity to increase the comfort of working officers. Furthermore, a conducive environment enables each individual or officer group to work based on norms and values in achieving company goals. Several comfort factors, such as air movement and temperature, humidity, as well as radiant heat, contribute to sick-building syndrome [56][57].

Indoor air quality (IAQ) and thermal comfort

Indoor air is within a building occupied by a group of people with different health levels for at least one hour. Indoor Air Quality (IAQ)[58][59] is a description of air conditions that are adequate for human occupancy inside a building

[60]. The IAQ considers the indoor environment, including the air and comfort factors related to temperature and humidity. Inadequate ventilation increases indoor pollutants because there is insufficient air from outside to dilute emissions from indoor sources. IAQ problems are caused by office equipment, chemical cleaning materials, and the occupants themselves [26][60].

The problem of indoor air conditions causes total organizational dysfunction when not handled seriously because it reduces officers' productivity [61].

Bad IAQ causes health problems, such as eye irritation, mental fatigue, and headaches [26]. The officers' concentration and productivity are influenced by working space comfort, which is increased by improving air quality. Maintaining proper air quality is a shared responsibility between officers and stakeholders.

Another factor in maintaining the quality of the work environment is thermal comfort [62]. This is a state of mind that expresses satisfaction with the thermal environment. Extremely hot or cold room conditions cause inconvenience. It is influenced by user characteristics and culture. Therefore, it is necessary to evaluate the thermal conditions in the work environment. High-temperature conditions in the room cause fatigue in officers, while low temperatures result in a feeling of cold. These conditions have an impact on the officers' productivity [63][64].

According to Saberi, (2009), several thermal comfort factors contribute to the symptoms of the sick-building syndrome, including air temperature and circulation, humidity, as well as radiant heat. This syndrome is associated with irritation of the eyes, nose, and headaches.

Lighting and noise

Lighting is an essential factor in creating a good work environment that provides comfort and increases officers' productivity [65]. Good lighting is one of the factors that improve vision conditions [57][65]. The work efficiency is determined by accuracy when looking at work. Therefore, lighting increases work effectiveness, as well as greater job security [66].

The office is not filled with natural lighting in the building. However, lighting poses its health challenges, affecting officers' service at work. De Carli & De Giuli (2009) explained that some design professionals fail to include lighting requirements at an early stage. As a result, when the lighting requirements are not met, the productivity level in the workplace is affected.

Current developments in technology have forced designers to include lighting as a necessity in the office environment to increase productivity [67]. The lighting choice in the office should support both paper and computer-based work. Lights emitted by computer screens contribute to several health challenges to the occupants when they are not set correctly. Poor lighting quality in the workplace causes eye fatigue, dizziness, and stress [26][68]. Also, lighting reduces or enhances the mood and motivation level of individuals in the building. Samani's research (2011) stated that the lighting quality in office buildings is related to work productivity. This is because without high-quality lights, productivity decreases.

Apart from lighting, there are other factors affecting work productivity, such as the noise aspect. Office noise causes officers to concentrate less on their work [69]. According to Al-Anzi (2009), noise causes stress, headaches, and other disorders [26][69]. Noise levels beyond the threshold value lead to hearing loss, as well as temporary and permanent damage risk to the ear. This happens after being exposed for a specified period without using adequate protective equipment[64]. Concerning this potential risk, governments in various countries have made regulations that limit the exposure of industrial workers' voices [70]. Based on the Minister of Health Regulation No. 1405 of 2002, occupational noise exposure in industries should be less than 90 dBA, with an average time of 8 hours [71].

Office noise causes cardiovascular problems in its occupants in the long term [26][41]. Also, it affects workflow between officers, their performance, and individual job satisfaction [72]. Danielsson (2008) showed that there is a correlation between the work environment and the officers' performance. Furthermore, noise is considered a factor that negatively impacts officers' performance satisfaction.

Based on its effect on humans, noise is divided into irritating (less loud intensity, such as snoring), masking (sound that obscures clear hearing, and indirectly affects occupational health and safety), and damaging or injurious (sound that exceeds the Threshold Value). It damages or reduces hearing function [16][74].

Noise above 80 dB causes restlessness, malaise, tiredness of hearing, stomach pain, and circulatory problems. Excessive and prolonged noise leads to disorders such as heart disease, high blood pressure, and stomach ulcers. The detrimental effects of noise on work and production efficiency have been demonstrated statistically in several industrial fields.

Availability of workspace: between productivity and work environment

The office is the main supporting facility for someone to work well. For this reason, the interior design of Haleyora Powerindo office is very much needed to create a comfortable and safe office atmosphere. Office design includes solving the problem of space requirements, furniture layout, circulation of human movement, and application of space-forming materials. This should be conducted in line with the design concept derived from the company's vision and mission.

Office interior, as a working area, is designed to solve the problems of related needs by considering the elements of space and comfort[46]. Therefore, the space design has to support activities, work comfort, and the area size according to the standard. Moreover, it should

consider the furniture layout towards the circulation of human movement, and the application of space-forming materials.

Standardization of workspace requirements for companies under the coordination of the State-Owned Enterprises Ministry of Indonesia is based on a copy of the Regulation of the Minister of SOEs Indonesia number Per-07/MBU/2012. This concerns the Standard Operational Procedures for Management of State Property within the Ministry of State-Owned Enterprises and Directorate General of Human Settlements Indonesia. Furthermore, it is based on the standardization of Architects Data by Ernst Neufert, Interior Design and Space Planning by Joseph De Chiara, Julius Panero, Martin Zelnik, Interior Design Handbook of Professional Practice by Cindy Coleman, and Human Dimension and Interior Space by Julius Panero, Martin Zelnik. The standard space area, based on position in the office [53][55] is:

Table 1: Outdoor Needs

No	Positions	Space area
1	Top Executive	38,74m^2
2	Middle Manager	12,47m^2
3	Supervisors	6,14m^2
4	Modular Workstation	2,52m^2
5	Conference Room	7,5m^2 per individual
6	Reception Room	8,5m^2 per individual
7	Main Corridor	2–3m (width)

The right office arrangement stimulates interaction between officers, which increases productivity in the workplace [72]. Adequate workspace increases concentration and interaction with one another. Furthermore, various information related to work increases organizational productivity because experienced officers assist those that are still a novice. Vischer (2008) showed a correlation between workspace design and officer performance. A well-designed workspace stimulates officers' performance and productivity because they are motivated to work regularly in a conducive environment [26][76][77]. The officers spend most of their working time indoors. Therefore, a properly designed office space has to be provided with facilities and furniture according to the officers' needs [26][78].

METHODS

This research uses a case study [79], with a Mixed-Method Research (MMR) approach in data collection and analysis [80][81]. The case study was chosen because it is possible to examine a phenomenon exploratively by looking closely, deeply, and in a natural context [79][82][83]. Case studies are not isolated experiences or events but reflect a broad and dynamic setting in which data is gathered from relevant, multiple sources [79]. The research began by qualitatively analyzing spatial conditions based on standardization, and the state of the room after being used. Furthermore, a quantitative approach was conducted by distributing questionnaires to all officers, managers, and Haleyora Powerindo staff. The research took 4 months, from September to December 2019. Respondents were asked to respond about the room design before and after they occupied it. It was intended to conclude to inform future decisions in creating a similar interior design.

This research was conducted in two stages, including physical spatial analysis based on the design results, and post-occupancy analysis. The first stage used a qualitative approach based on an in-depth study that is compared with the standardization of basic design theory. This stage started from:

1. In phase one, data were collected through observation of HPI office plans, including space and circulation, furniture layout, and supporting facilities, as well as materials used. Next was the measurement of the space area and the distance between furniture. Finally, there was documentation and drawing furniture layout plans.
2. In phase two, data were analyzed using a comparison method of existing conditions with literature and standardization of basic theory (Regulation of the Minister of State for SOEs RI number: Per-07/MBU/2012 concerning Standard Operational Procedures for Management of State Property; Architects Data by Ernst Neufert; Interior Design and Space Planning by Joseph De Chiara, Julius Panero, Martin Zelnik; Interior Design Handbook of Professional Practice by Cindy Coleman; and Human Dimension and Interior Space by Julius Panero, Martin Zelnik).

A quantitative approach was used in the second phase through a questionnaire survey, using voluntary participation principles to all respondents. Therefore, the openness and honesty of respondents were the main aspects of this study[84]. The questions were discussed with directors that were not part of the research subject to prevent conflicts of interest. At this stage, the research steps were open interviews, exploratory questionnaires, spatial syntax analysis, and photo documentation.

Questionnaires were distributed physically to respondents and returned after being filled out through the internal delivery system. From the 80 questionnaires distributed, only 75 (93.75%) were returned, indicating a high participation rate. Several instruments, procedures, and data analysis methods were used in this study. The questionnaire contained 30 multiple-choice questions on a Likert scale. The questions were designed to obtain officer perceptions data about appearance, privacy, and security of space, policies governing their use, and their preferences in utilizing spaces. Data were analyzed using SPSS software. Open interviews were conducted directly for about 15 minutes. They were used as a deepening form of the questionnaire results aimed at data verification. Moreover, the interviews aimed to produce

richer data and narrative. All interview documentation was recorded, and the data were used to verify the questionnaire results. The data for space syntactic analysis were taken from the ground, 2nd, 3rd, and 4th-floor plans, and converted into a visibility graph produced by depthmapX.7. Photo documentation is used to compile all use of the workplace.

Research procedure

The Mixed Methods Research (MMR) approach used an exploratory design. This design uses qualitative and quantitative approaches, as shown in Figure 1 below.

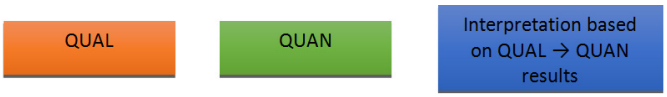

Figure 1: Exploratory type design

Based on Figure 1, the MMR type emphasis is more on a qualitative and is complemented by a quantitative approach. The mixing of data from both approaches connects the results of the first research and the next stage. The next step is data triangulation [80][85], which strengthens the research reliability. All data were analyzed through 3 stages, including reduction, presentation, as well as drawing conclusions, and verification.

The temporary conclusion was drawn from the results of data reduction and presentation. Furthermore, it was conducted by verifying the data in the field. The data were verified by plunging back into the field to obtain new evidence [85]. Standard conclusions are made when the data obtained has similarities.

Research Object

The research was conducted in the HPI Jakarta building, which had been redesigned for the interior space atmosphere from the ground to the 4th floor. Planning and designing of space atmosphere are based on the needs and organizational structure of the company, as outlined in the design Term of Reference (TOR). The research object was chosen because redesigning the HPI building applied the green concept and open space interior design. The design plan data from the ground to the 4th floor is in the figure below.

In this case, an analysis of the workplace used by the Board of Directors, division heads, and officers is based on the aspects of space, supporting facilities, formation elements, and materials used. A comparison with standardization was based on observations of design results and data in the field.

In line with the company's vision and mission as a public service institution, space grouping is based on service levels. The ground floor is used for groups of consumer service rooms and displays. It consists of rooms, such as entrance, lounge, waiting, toilet, mosque, KSO, BUJP, display, training and recruitment, archives, lockers, pantry, lift, and stairs. The 2nd and 3rd floors consist of rooms for display, counter, meeting, archives, division, and staff work, lounge, pantry, lift, and stairs. The 4th floor consists of rooms meant for directors, secretary of directors, managers and staff, lounge, meeting, archives, toilet, warehouse, pantry, lift, and stairs. Based on the analysis results using existing standardization, space meets the minimum requirements for the workplace.

Figure 2: HPI Building re-design plan of ground floor, 2nd floor, 3rd floor, and 4th floor

Research respondents

There were 80 research respondents, 48 men, and 32 women, representing the level of position from directors to officers. All respondents are permanent officers at the company. Out of the total number of respondents, 52 have work experience of more than 10 years, 19 people between 5 to 10 years of experience, while 9 are new officers with no experience, as seen in table 2 below.

Table 2: Directors and staff of PT. Haleyora Powerindo

No	Position	Total
1	President Director	1
2	Director of Finance	1
3	Director of HRD	1
4	Company Secretary	1
5	Secretary of the Board of Directors	1
6	Divisions and Managers	15
7	Staff	60
Total		80

From 80 research respondents, 75 filled out a questionnaire, with details of 42 men and 33 women, consisting of all respondents outside the board of directors and their secretary.

RESULTS AND DISCUSSION

The results of this study are divided into 2 parts. The first analysis was based on physical space. The second was based on the 'officer's opinions after occupying and using the space.

Appraisal

In this discussion, an analysis of spaces is conducted based on spatial aspects, supporting facilities, and forming elements

- Director's office

The directors' room is placed on the 4th floor, measuring 4.00m X 10.00m = 40m^2. It is divided into workplace zones, meeting rooms, as well as service and toilets, as shown in Figure 3 below.

From Figure 3 above, the workplace for the Board of Directors, based on Government and Cipta Karya standards, is 25m^2. Furniture needs for this room include 1 set of work tables, 1 chair and 2 facing chairs, 1 set of discussion table for 6 people, 1 set of guest tables and chairs, 1 set of cupboard and credenza, as well as a special toilet measuring 2.00mX2.80m=5.6m^2 (Closet, washbasin, and shower).

- Head Division and officer, or Staff Workplace

Officer workplaces are located on the 2nd, 3rd, and 4th floors. These workplaces are grouped based on the company's organizational structure, where each division is in one zone. For instance, the Control and operational Division consists of 1 Division Head, 4 managers each assisted by 6-8 staff. The basic design concept uses an open plan with a co-working space model. As a result, the existing space tends to be open without wall dividers. The existence of a special glass wall divider, starting from the level of the division head to the board of directors, ensures privacy. However, it is still designed to use a transparent glass wall. Therefore, leaders communicate and control the 'officer's activities.

The open space condition gives the impression of a large area with a clear circulation. The entire staff room on the 2nd, 3rd, and 4th floors is divided into 2 parts, the collaborative and individual work zones, as shown in Figures 4, 5, and 6. This division is in line with the basic concept of activity-based work areas and zoning by considering the intensity of officer obligations.

The implementation of this model provides an opportunity for active collaboration and discussion processes among officers. Bright room color selection supported by artificial lighting using LED lights, as well as temperature setting, evoke creativity and productivity, as well as boosting officer performance.

Based on analysis results by comparing field data with space standards, this setting meets the requirements. This is evidenced in the leaders and managers following the minimum standard of the workplace (32m^2-15m^2). Also, there are facilities of 1 set of work desks, 2 chairs facing, sofa for 2 guests, and 1 credenza. The Board of Directors has a meeting table of 6 people. Officer workplaces use the co-working space concept by using a minimum area of 2m^2, with a desk and work chair pro-

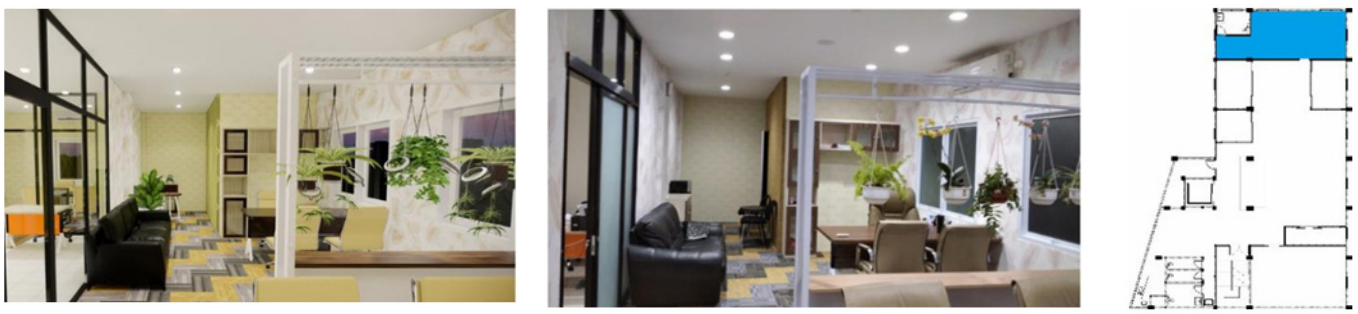

Figure 3: Workplace conditions of the director of HPI Jakarta on 4th floor

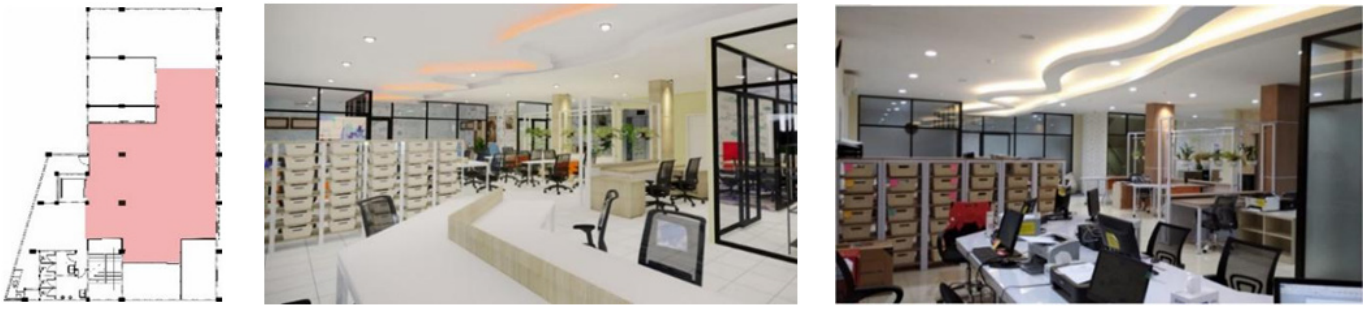

Figure 4: Officer workplace on the 4th floor (a. Floor plans; b, c. Workplace atmosphere)

Figure 5: Officer workplace on the 3rd floor (top: a, b. Workplace atmosphere; c. Floor plan; bottom d, e. Workplace atmosphere)

Figure 6: The atmosphere of the office workplace on the 2nd floor

vided. The data management division is divided into 2 types. First is the hard copy data in the filing cabinet, meant for archiving essential documents or use paperless concept. The second type is the soft copy on the main server, which is placed in the dynamic archive room and is united with printers and photocopies.

From the results of the space analysis carried out, it still leaves space that the researchers have not done, namely in the aspect of consideration of furniture selection related to ergonomics and anthropometry of users according to their characteristics, social, and culture. This provides an opportunity for researchers to do more in-depth. Because ergonomic and anthropometric factors are important in designing the atmosphere of an office space, where employees have a lot of activities in the room.

Configuration analysis

The syntax space analysis method was used to determine how the layout functions. Moreover, it showed what the user sees from various points in space, and as area navigation viewed from the level of ease and difficulty in achieving space. In interior design, it is vital to group and place space zones according to room function. The syntax space analysis produces a combination of visibility graph, and the visibility polygon (Isovist) of the zoning plan for space function, as shown in Figure 7 below.

Based on Figure 7 above, the spatial organization graph shows the relationship between adjacent spaces. Furthermore, it indicates the direct connection as a Syntax steps concept on 1st-4th floors, where stairs (T) and lift (Q) connect all the floors. All the rooms connected to

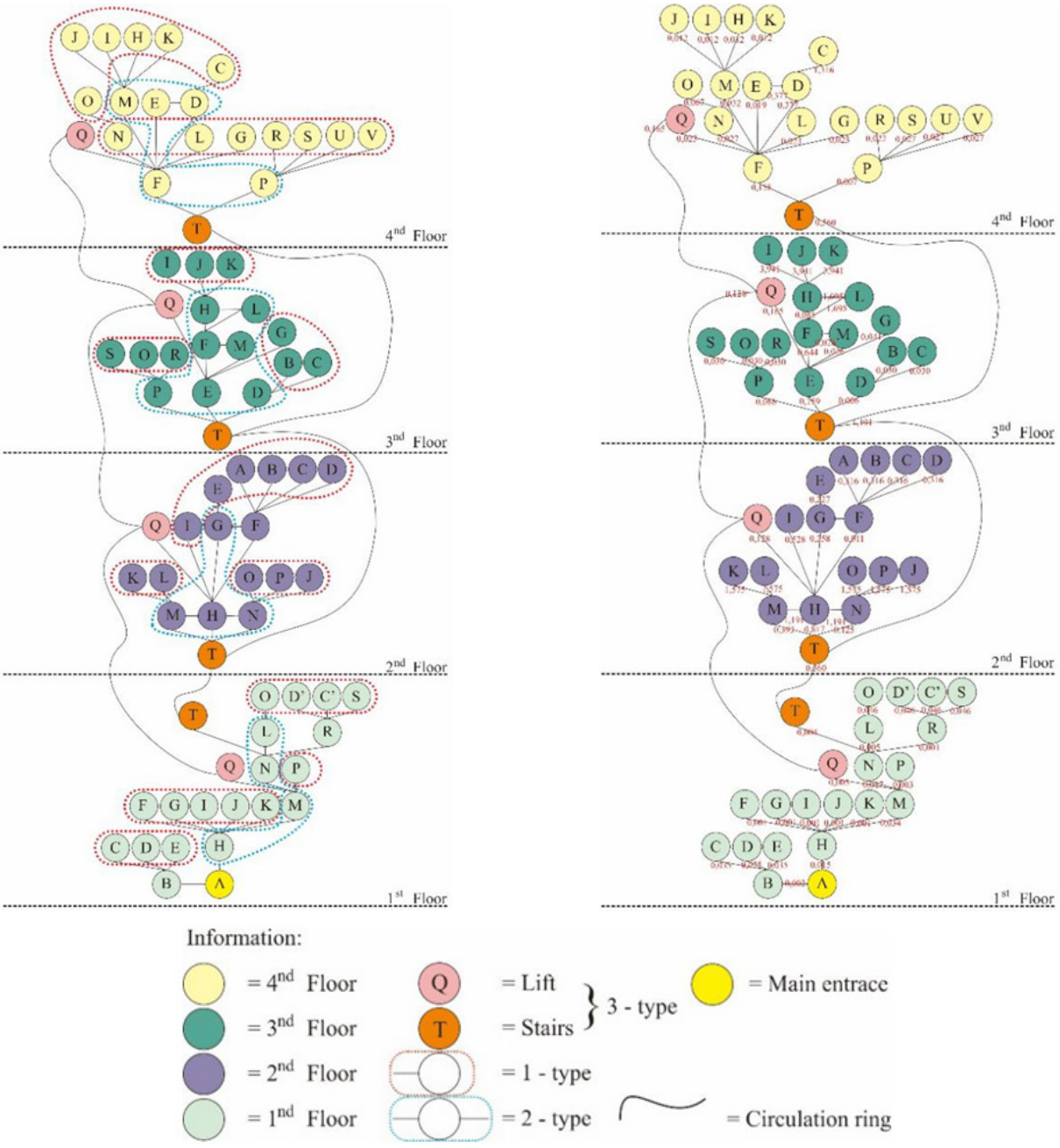

Figure 7: The organizational graph is a spatial relationship between adjacent spaces in a building

the main entrance are one syntactic step and pulled one step onto it. The more levels in an image, the deeper and less accessible the space for the user. Spatial space relationships form a network structure between spaces, in which users must pass by room to reach the farthest distance. This configuration describes the layout and organization of space hierarchically, according to room function. Nodes and their inter-connectivity represent several types, including. They include dead-end spaces connected only to one each (type 1), a room connected to two or more rooms (type 2), and spaces located on stairs and lifts (type 3).

The analysis of the relationship between spaces is followed by spatial analysis, using Isovist in the form of a VGA integration diagram. This analysis is used to identify the visual plane of space position in a closed polygon.

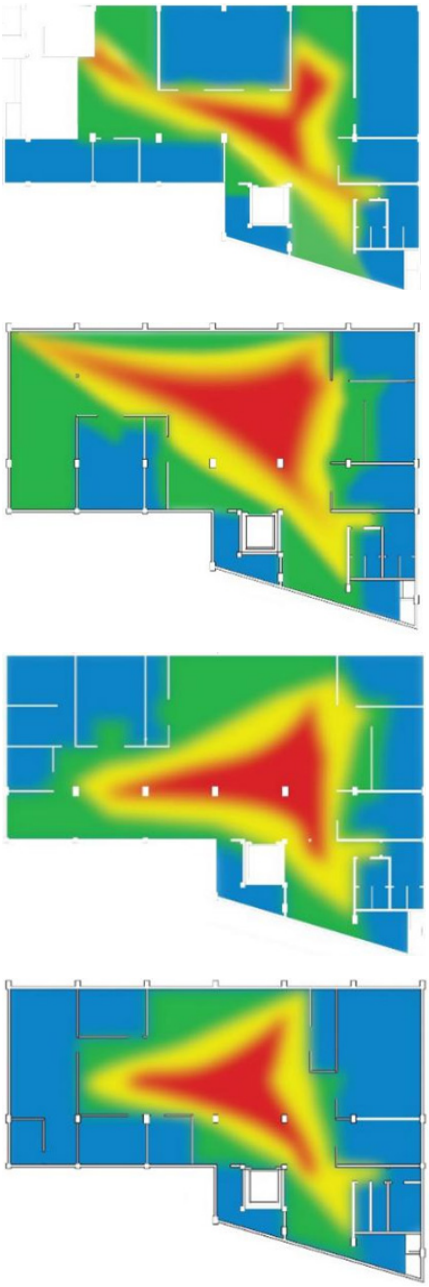

Figure 8: VGA integration graphics

Based on Figure 8, VGA shows the extent to which the rooms are connected in the configuration. It is seen in the visual integration, which describes how deeply the spaces are connected in the existing configuration. This integration correlates with the use of space and social user meetings. More visually integrated areas are highlighted in red, indicating potentially higher levels of space use, movement, and activity. On the first floor, a room with a high integration degree is in the waiting room, GRO and K3 displays, as well as security. This is in line with the design objectives in the HPI office, where the room on the 1st floor functions as the company storefront.

The workplace with the co-working space concept is an open area and close to the manager's room. Therefore, it has a high integration degree, as seen visually highlighted in red at the staff workspace area. A separate and private area appears in blue as a deeper space, used by the manager, and serves as a director room. Although the integration value from space organization is low, the manager is still able to see and control staff work activities directly. The level of mean integration and standard deviation were calculated per space, as in Table 3 below.

Table 3: Isovist and VGA Analysis

	Isovist area % of Floor Area	Mean Integration	Integration SD
1st Floor	19,89%	4,08	1,15
2nd Floor	37,59%	7,57	2,18
3rd Floor	71,05%	14,29	6,00
4th Floor	21,86%	4,40	1,86

Based on table 3, the Isovist is the visible area from several rooms, where visual accessibility follows the building's geometry and axes. Integration mean shows the average level of visual integration. The higher the average, the more integrated the space, indicating increased visibility level in the configuration. The integration standard deviation shows the variation degree in the integration space within the configuration. The majority of spaces in configurations with lower SD integration tend to be closed or open.

Indoor environment quality (IEQ)

This research is limited to the scope of the indoor environment in the environmental assessment method according to the outline of the Green Building Assessment (GBA) method [86], including Air Quality, thermal quality, and natural lighting.

Indoor air quality

Based on the opinion about the air condition in the room, 49% of respondents rated it as normal, 34% said that they felt the fresh air, while 3% rated it as stale. The results are seen in Figure 9.

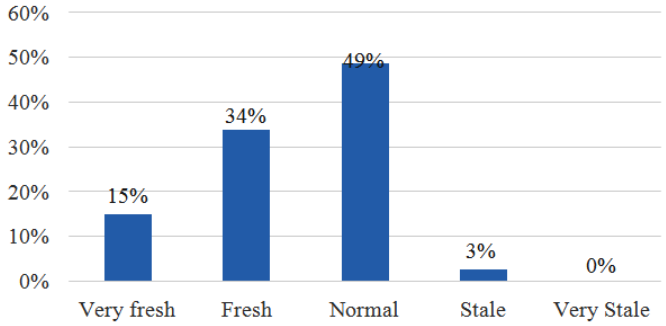

Figure 9: Air condition in the room

Based on the respondent's opinion about the air humidity level in the room, 85% stated it was normal, 11% said it was dry, while 4% said it was humid, as seen in Figure 10 below.

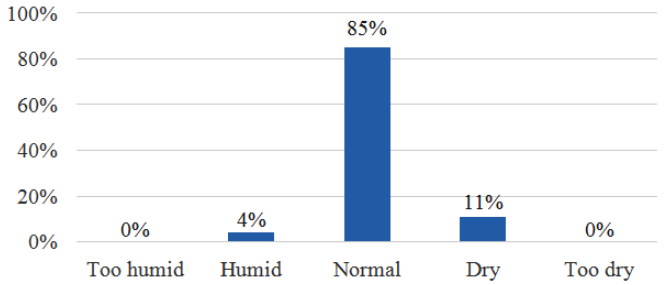

Figure 10: Humidity conditions in the room

As many as 4% of respondents stated that there was little air circulation in the room, 86% stated that it was good, while 9% stated it was very good.

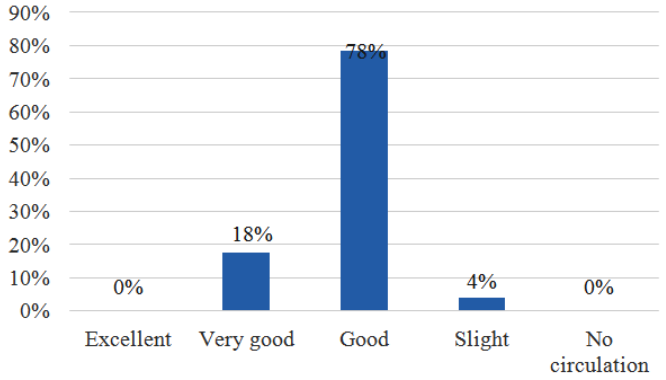

Figure 11: Air Circulation

Based on Figure 11, respondents were satisfied with the air quality in the office room.

Thermal comfort

Of the 75 respondents, 52% of them stated that the indoor air temperature was quite cold, 45% said it was warm, while 3% felt very cold. This shows that the room temperature is well controlled, as seen from a respondent's opinion that it was quite cold, as seen in Figure 12 below.

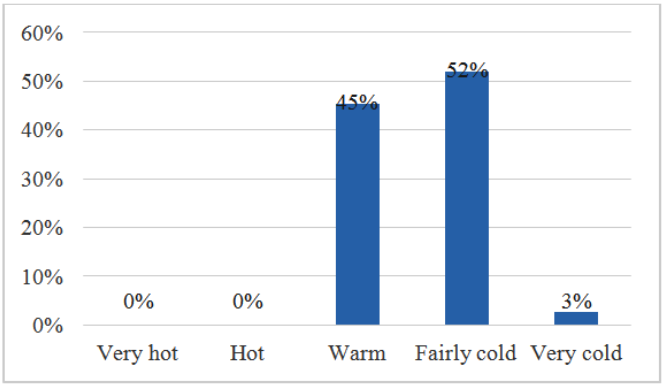

Figure 12: Thermal comfort

Natural lighting

Out of the 75 respondents that were asked about the natural lighting conditions in the room, 4% of them thought that there was much natural light, 43% indicated that it was moderate, 48% indicated that there was little natural light, while 5% indicated that it was very poor, as seen in figure 13 below.

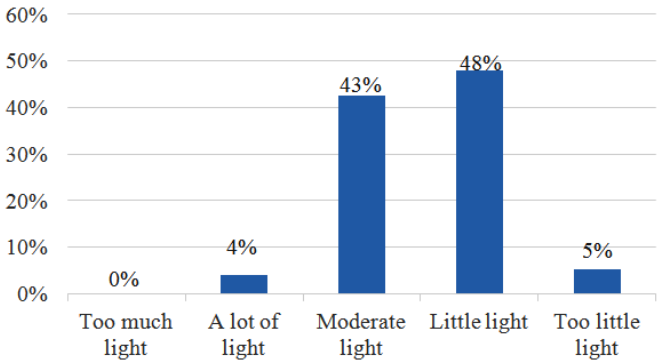

Figure 13: Natural lighting in the room

Out of the 75 respondents, 54% indicated that artificial lighting was sufficient in the room, 43% stated that it was light, while 3% that it was very bright, as shown in Figure 14 below.

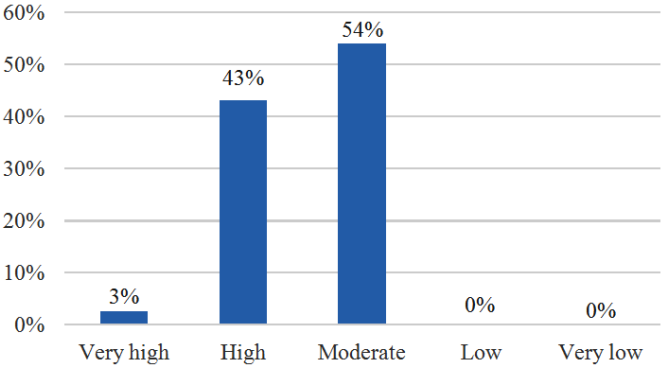

Figure 14: Artificial lighting

Based on Figure 14, most officers may never experience eye health problems as a result of artificial lighting. Artificial lighting is used to supplement insufficient natural lighting. This uses soft lighting type LED lamps that are energy saving. Also, they do not interfere with the officer's eye health.

Window curtains are used to block out natural light in buildings, especially during the daytime sun. Therefore, 60% of respondents stated that the curtains are effective in blocking natural light, 29% stated that curtains are more effective, while 7% stated that curtains are very effective, especially between 11.00 AM and 4.00 PM, as shown in Figure 15 below.

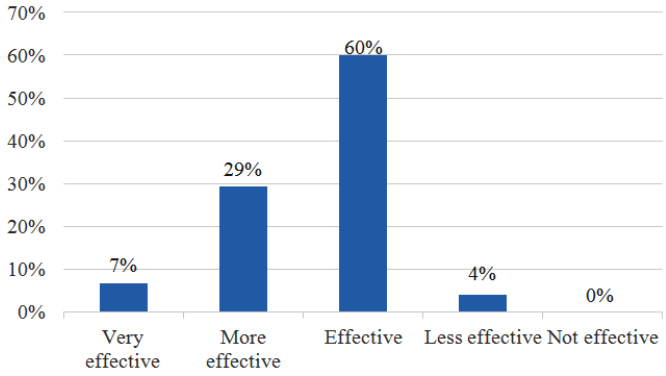

Figure 15: The use of curtains on window

Related to the IEQ, the results of the trend test calculations using SPSS v. 25 covered the 3 aspects, including indoor air quality, thermal comfort, as well as natural and artificial lighting conditions. Of the 75 respondents, 44% gave very high ratings related to indoor environmental conditions (IEQ), 47% gave high ratings, while 9% gave moderate values, as shown in Table 4 below.

Based on Table 4 above, the average respondent opinions on air conditions, humidity levels in the room, thermal comfort, and lighting conditions tend to be positive.

The results of the IEQ which consider indicators of air quality, thermal comfort, and natural lighting (BCA standards) affect office conditions. These three indicators are factors from the physical environment that affect employee productivity. Figure 9-15 shows the IEQ database based on the average employee satisfaction score related to air quality indicators, where employees expect the air condition in the room to be normal and have good air circulation, not stale and not humid. Meanwhile, related to thermal comfort Most of the employees stated that the room conditions were cold, this was due to the use of air conditioning that was turned on during working hours. The existence of window openings provides a solution other than natural lighting as well as part of air circulation processing so that indoor air conditions are more normal.

Respondents' perceptions of indoor environment quality tend to give high ratings. Where controlling the work environment will create a work environment that is healthy, safe, comfortable, and productive for employees. Lighting, air, and sound as physical environments that affect office conditions. Activities in the office require a quantity of light that must be fulfilled so that work productivity increases.

Work environment/Workplace quality

The level of satisfaction with the workspace interior conditions

Officers' satisfaction levels are grouped into 5 main indicators, including space flexibility, office conditions, safety in buildings, space for movement, and noise levels. The survey results showed that, of the 75 respondents on the space flexibility aspect, 5% were very satisfied, 65% were quite satisfied, while 29% were satisfied, as shown in Table 5 below.

Table 4: Respondents' responses about IEQ

	Respondent		Mean	Std. Deviation	Category		
					Very high	High	Moderate
Indoor Environment Quality (IEQ)	Male	42	18.0933	1.1988	44%	47%	9%
	Female	33					

Table 5: The satisfaction level in the workspace interior

	Response (%)				
	Space flexibility	Office conditions	Safety inside the building	Workspace area	Noise pollution
Very satisfied	5	11	0	11	20
Quite satisfied	66	85	3	63	69
Satisfied	29	4	29	26	11
Less satisfied	0	0	60	0	0
Not satisfied	0	0	8	0	0
Total	100	100	100	100	100

Apart from the flexibility aspect, the respondent's opinion is related to the office condition. Out of the 75 respondents, 11% were very satisfied, 85% were quite satisfied, while 4% were satisfied. This was in line with the condition which, at that time, had just undergone a complete interior redesign. From the respondents' opinions related to safety in buildings, 8% expressed dissatisfaction, 60% expressed were less satisfied, 29% were satisfied, while 3% were quite satisfied.

Related to the workplace area, 11% of respondents said they were very satisfied, 63% were quite satisfied, while 26% were satisfied. Out of the 75 respondents' opinions regarding the noise level coming from outside, 20% said that they were very satisfied, 69% were quite satisfied, while 11% were satisfied.

Work environment / Workplace quality and work productivity levels

The work environment affects the productivity level. It is influenced by temperature, noise, and lighting[26]. Based on the 75 respondents' opinions about the effect of air quality on their work productivity, 29% stated that air quality significantly affected work performance and productivity, 66% stated that air quality had a significant impact, while 25% stated that air quality affected the work performance and productivity. Regarding the office space temperature, 19% of respondents stated that the temperature greatly affected work performance and productivity, 72% stated that the temperature had a considerable effect, while 9% stated that the average temperature affected performance and work productivity. These results are seen in Table 6 below.

When asked about indoor noise levels, 64% of respondents stated that the noise level had a significant effect on productivity and performance, while 29% stated that it had a considerable impact. This is in line with their statement that they are very satisfied working indoors, out of disturbance by noise from outside.

Out of the 75 respondents, 69% stated that the indoor lighting quality had a significant effect on productivity and performance, while 31% stated that it had a considerable impact. This statement is in line with the opinion of all officers that the lighting quality in the room is effective because there are no eye-related health problems. A small proportion (5%) stated that the quality of the existing room on average affects the productivity and performance, 67% stated that it had a considerable impact, while 28% stated that it had a significant effect.

The results from the calculation of the satisfaction level trend test for the work environment quality (WQ), using SPSS version 25 software were based on 7 technical aspects. They included workspace area, space quality, comfort and style characteristics of furniture, circulation, and accessibility to the work table, effectiveness and efficiency of workplace layout, the ICT implementation in officers work systems, the availability of social space and entertainment facilities, as well as HVAC and building maintenance as workplace design considerations. Of the 75 respondents, 33% gave a very high rating related to WQ conditions, 56% gave a high rating, while 11% gave a moderate rating, as shown in Table 7 below.

Table 6: The impact of the work environment quality on user productivity and performance

	Response (%)				
	Quality of air	Temperature in office	Distraction of noise	Quality of light	Quality of space provided
Major effect	29	19	64	69	28
Near major effect	66	72	29	31	67
Moderate	25	9	7	0	5
Near minor effect	0	0	0	0	0
Minor effect	0	0	0	0	0
Total	100	100	100	100	100

Table 7: Respondents' responses about WQ

	Respondent		Mean	Std. Deviation	Category		
					Very high	High	Moderate
Workplace Quality (WQ)	Male	42	16.28	1.6517	33%	56%	11%
	Female	33					

The quality of the indoor environment and the workplace affect officers' performance

Using the SPSS version 25 software, the results of the correlation calculation between the indoor environment quality and the officers' performance obtained a correlation value (r) of 0.955, while between the workspace quality and officers' performance was 0.815. In both results, the quality provides a strong and positive linear relationship.

Table 8: Multiple regression

Model summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.944a	.912	.938	9.562

Based on the table, the value of R=0.944. It means that the strength of the relationship between the quality of the indoor environment (IEQ), and the workspace (WQ), simultaneously with officers' performance (OP) is 0.944.

Based on the table, the regression equation obtained is Y=24,936+1,628IEQ+0,944 WQ.

Therefore, the constant value is 24.936, meaning that when the IEQ and WQ are zero, the OP value is 24.936. Furthermore, the regression coefficient of IEQ=1.628. This means that when other independent variables are fixed and IEQ increases by 1%, the OP increases by 1.628. The positive coefficient implies a positive relationship between IEQ and OP. The higher the IEQ, the more binding the OP value. Similarly, the regression coefficient of WQ=0.943. It means that when other independent variables are fixed and WQ increases by 1%, the OP increases by 0.943. The positive coefficient implies a positive relationship between WQ and OP. The higher the WQ, the higher the OP value. This means that the two factors, IEQ and WQ, significantly affect OP.

CONCLUSION

The results showed that the quality of the work environment was in the high category and responded positively. Where based on the results of multiple regression calculations, the quality of the IEQ and the quality of employee workspace (WQ) has a significant effect on employee performance (OP). The quality of the work environment, the quality of the workspace, and the performance of the employees are the 3 (three) main factors in conducting a systematic evaluation to get results from a sustainable office space design. Planning strategies that include increasing ventilation, reducing indoor pollutants, using green materials, using sunlight as a natural lighting system, having a control system in the use of air conditioning have a significant impact on creating an atmosphere of spatial space that opens up to green buildings (GB).

POE is used together with the MMR approach to systematically evaluate the survey results on the HPI office building after the spatial redesign, as well as being occupied and operating. Based on observations and measurements of the area, which is then compared with standardization, the interior of the HPI building fulfills the requirements, from the director's room ($32m^2$-$15m^2$) to the officers' workroom ($2m^2$). The quality of the indoor environment in the HPI building, from the IAQ, thermal, and lighting aspects, is (47%) and perceives it positively.

The workplace quality (WQ) indicates satisfaction with the area of workspace, space quality, comfort, and style characteristics of furniture, as well as circulation and accessibility to the work table. Also, there is satisfaction with the effectiveness and efficiency of workplace layout, ICT implementation, as well as HVAC and maintenance as part of considerations in this building redesign. The existence of social space and entertainment facilities gave a distinct impression that previously did not exist. This provides flexibility and freedom in interacting with officers in different divisions. Based on the correlation calculation, there is a relationship between the indoor environment quality and the officers' performance of 0.955. Moreover, a relationship exists between the workspace quality and the officers' performance of 0.815. It means that both qualities provide a strong and positive linear relationship. Based on the multiple regression calculation results, the indoor environment quality (IEQ) and the officers' workplace quality (WQ), simultaneously significantly affect officers' performance (OP) of R = 0.944, with the regression equation Y = 24.936 + 1.628 IEQ + 0.944 WQ.

The results of this study are still limited to the opinions of employees about the work environment and the quality

Table 9: Multiple regression equations

Coefficients								
		Unstandardized Coefficient		Standardized Coefficients			Collinearity Statistics	
Model		B	Std Error	Beta	t	Sig	Tolerance	VIF
1	(Constant)	24.936	9.757		4.930	.000		
	IEQ	1.628	.308	.551	5.892	.000	.459	2.177
	WQ	.943	.101	.496	5.297	.000	.459	2.177

of workspaces that affect their performance. Based on the results of this study, it is hoped that it can become a strategic reference for planning and designing a similar spatial atmosphere in different locations or cases. Further research needs to be developed in the future on the ergonomic aspect through the human-centered design (HCD) approach to obtain a single guideline for office design based on post-occupancy space performance and user participation.

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