Effectiveness evaluation scheme of ABW implementation for office

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ABW, work engagement, office layout

The United Nations has advocated for the Sustainable Development Goals, emphasizing the importance of work engagement. Innovations in office environment design contribute to improved productivity, and the practice of Activity Based Working (ABW) contributes to creating organizations with fulfilling work. In this investigation, we conducted subjective evaluations of work engagement and objective evaluations using wearable devices.

1. Introduction

One of the Sustainable Development Goals advocated by the United Nations in 2015 was “Decent Work and Economic Growth.” “Decent Work” is defined as “work worth doing,” with work engagement as a metric defined as “a positive, fulfilled psychological state with respect to work.” Work engagement is one of the key indicators that is supported by working space and has a significant impact on productivity. A pleasant, comfortable office environment enhances people’s motivation and stimulates their creative thinking. For example, by controlling factors like temperature and humidity in a space abundant with natural light, a comfortable atmosphere can be created, thereby reducing stress. Furthermore, a layout that maintains a reasonable balance between open and private spaces simultaneously promotes communication and improves concentration. Conversely, noisy, cluttered environments and spaces lacking functionality diminish people’s concentration and lead to a decrease in productivity. Enhancing work engagement through the creative use of space is a key to enabling people to immerse themselves in their work, gain satisfaction, and improve the performance of the entire organization.

Activity-Based Working (ABW) has come to be known as an example of this. The goal of ABW is to create an environment that enhances job satisfaction by aligning with people's aspirations for growth and self-actualization. In ABW offices as well, unlike in conventional offices with fixed seating, employees choose the location that allows them to work most efficiently depending on the type of work they are doing.

We measured the impact of changes in the workplace environment from the perspective of how the alteration of such office environments leads to improved productivity in the future.

We performed this research in two stages: the first a subjective evaluation of work engagement using a questionnaire. And the second, an evaluation based on the data obtained by having subjects wear a wearable device. This report focuses on these two evaluation methods.

2. Changes in office environment

Here, we describe the changes in the office space at Azbil Corporation's Fujisawa Technology Center, which carried out an evaluation of its transition to an ABW office. Figure 1 shows how it looked prior to the renovation that took place during July 2022. The desks were arranged in a way that ensured ample aisle space, creating a uniform office atmosphere. With the renovation that took place starting in August 2022, cubicles (fig. 2), a café-style workspace (fig. 3) and booths (fig. 4) were introduced into the office work environment. This made it possible for employees to freely choose where to work, be it a group environment, or one partitioned off from others when they want to immerse themselves in their work.

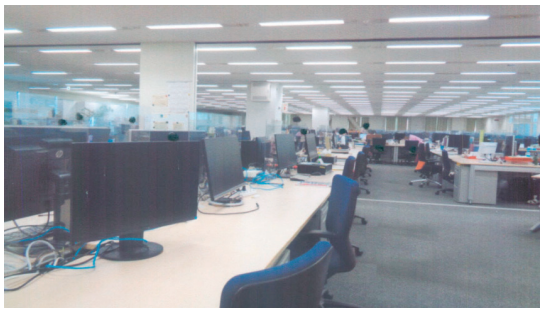


Fig. 1. The office prior to the renovation

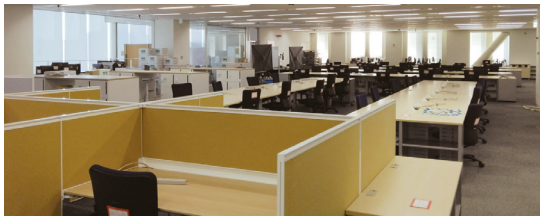


Fig. 2. Cubicles following renovation

Fig. 3. Café-style workspace

Fig. 4. Booths

Compared to the number of closed conference rooms that were used until that time, there are fewer partitions to block out noise and prevent visibility to others, but they are being used more frequently.

3. Subjective evaluation pertaining to office renovation

We conducted a questionnaire survey on work engagement using a form that could be completed online.

Work engagement is an indicator of how enthusiastic and passionate employees are about their work, and to measure it we asked a variety of questions designed to assess multiple aspects of work, including job satisfaction, enthusiasm, and immersion.

We conducted a subjective evaluation of whether the workspaces enabled efficient and comfortable working conditions, looking at how the various spaces were used depending on the type of work, whether they were suited to individual work requiring concentration, or collaborative work that emphasizes communication, and whether the workspace felt refreshing and casual. We performed this evaluation using "subjective work efficiency (from 0% to 100% with 100% representing the highest work efficiency)" and the "Utrecht Work Engagement Scale (UWES)" [3]. We also came up with approximately fifty questions to evaluate work function impairment using the Work Functioning Impairment Scale (WFun).

Table 1 shows some of the questionnaire items.

Table 1. Questionnaire items (excerpt)

	Item
1	Various types of desks and workspaces are available so that employees can change their location to match the nature of their work.
2	There are locations inside the office where employees can be by themselves and concentrate without being distracted by surrounding noises.
3	Desks are separated by partitions or panels so that employees don't need to worry about being observed by others.
4	The distance is such that employees can casually talk to each other while working.
5	It is an office environment where employees can work while enjoying the atmosphere of their surroundings.
6	There are dedicated spaces for employees to conduct phone calls or video conferences without worrying about their surroundings.
7	There are adequate spaces for small groups to work together.
8	There are private rooms and spaces where supervisors, subordinates, colleagues, etc. can have relaxed one-on-one conversations.
9	There are facilities suitable for small groups of employees to share information or hold brainstorming sessions.
10	There are facilities and meeting spaces where small groups can exchange information on the status of their work.
11	There are spaces suitable for the sharing of knowledge.
12	There are spaces that are easy for employees to use to refresh themselves.
13	There are easy-to-use spaces designed to stimulate conversations among employees.

Respecting the responses of each individual, and ensuring the accuracy and reliability of response data was essential. We needed to create an environment in which each employee could honestly report their opinions and experiences. Additionally, upon administering questionnaire surveys, special care needed to be taken with respect to the handling of personal information.

To enable employees to freely state their opinions, it was ideal for the questionnaire to be administered in an anonymous format. For this survey, each respondent was asked to generate an individual code (ID) with their work computer, and to pro-

vide it when responding to the questionnaire. We matched the IDs attached to the survey responses from before and after the ABW transformation, and based on the data from the matching IDs, we analyzed the changes from before to after the transformation.

4. Effects verification based on a questionnaire survey

From June 28 to July 29, 2022, we conducted a questionnaire survey on working in the office just before the renovation. We conducted a second questionnaire survey on working in the office from July 3 to July 31, 2023, a year after the renovation had been completed, and then carried out a comparative analysis of the 238 individuals we could link by ID. Figure 5 shows the results before and after the renovation. A solid red line indicates improvement in the "very suitable" category, and a dotted red line indicates improvement in the "somewhat suitable" category.

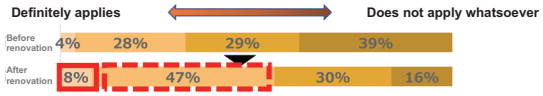


Fig. 5.1. Various types of desks and spaces are available, allowing employees to change locations based on the nature of their work.

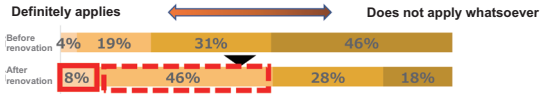


Fig. 5.2. There are locations inside the office where employees can concentrate by themselves without being distracted by surrounding noise or voices.

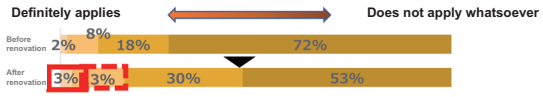


Fig. 5.3. Desks are separated by panels so that employees don't have to worry about being observed by others.

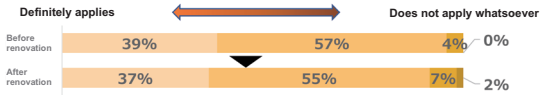


Fig. 5.4. The distance is such that people can casually talk to each other while working at their desks.

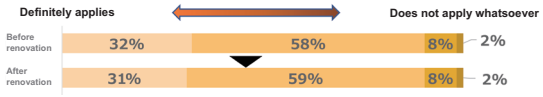


Fig. 5.5. The office environment is designed to allow employees to work while enjoying the atmosphere around them.

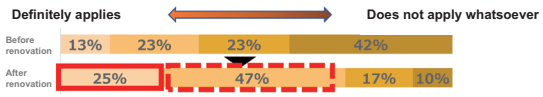


Fig. 5.6. There are dedicated spaces for employees to conduct phone calls or video conferences without worrying about their surroundings.

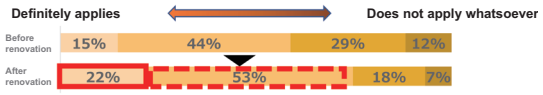


Fig. 5.7. There are adequate spaces for small groups (of two or three) to work together on tasks such as data editing and processing.

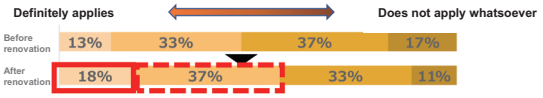


Fig. 5.8. There are private rooms and spaces where supervisors, subordinates, colleagues, etc. can have relaxed one-on-one conversations.

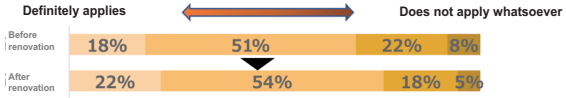


Fig. 5.9. There are facilities suitable for small groups to brainstorm ideas while browsing information on websites or using sticky notes or whiteboards.

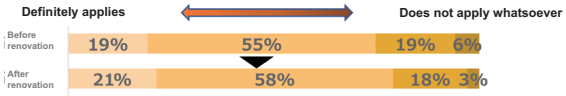


Fig. 5.10. There are facilities and meeting spaces conducive to the sharing of information on work status (including workshops and report meetings) by large numbers of employees.

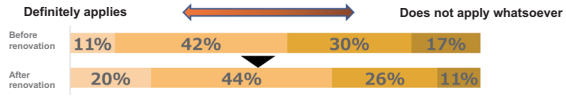


Fig. 5.11. There are spaces suitable for the sharing of knowledge.

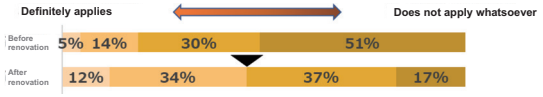


Fig. 5.12. There are spaces that are easy for employees to use to refresh themselves.

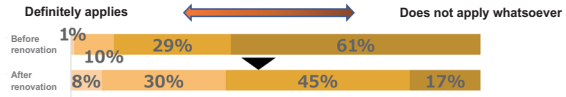


Fig. 5.13. There are easy-to-use spaces designed to stimulate conversations among employees (foyer, lounge, etc.).

The introduction of a wider variety of workspaces within the office, offering more choices of where to work, is likely to have contributed to improving satisfaction levels in each area. However, there are cases where this is not the case, even if satisfaction increased slightly. There were some survey items for which no significant improvement in satisfaction was observed, but in these cases it is believed that the pre-existing work spaces were already conducive to communication, and that the level of satisfaction was maintained even after the renovation.

4.1 Evaluation using Utrecht Work Engagement Scale (UWES)

One widely used measure of work engagement is the Utrecht Work Engagement Scale (UWES). It measures how actively and enthusiastically employees engage in their work. We compiled our survey using an abridged version of UWES consisting of nine categories of questions, including “I feel energized when I work,” “I feel happy when I am immersed in my work” and “I am able to work at my own pace.” These areas are evaluated based on elements that make up work engagement, such as “vitality,” “enthusiasm” and “immersion.” When measuring the degree of work engagement with the UWES, respondents answer based on which one out of the six possible categories fits each question. A frequency-based scoring system is used, with options such as "Not at all" and "Hardly ever feel it (less than a few times a year)." Each option is given a point value (pt).

The results from the survey of 238 respondents showed that there was little change before and after the transition to ABW.

4.2 Evaluation of work functioning impairments

Labor productivity is a metric that reflects the work efficiency of employees. As a health-related factor that lowers productivity when employees come to work despite being in poor physical condition, the act of working while ill should ideally be eliminated. However, there are instances where this behavior persists, leading to decreased productivity. Illness and stress prevent employees from performing at their best, causing a decline in the quality and efficiency of their work. To assess these impairments in work functioning, we chose to use the Work Functioning Impairment Scale (WFun), and we evaluated changes in work capability that occur after employees are affected by physical and mental health issues. Coming to the office while ill and impaired work function are interrelated, and both are factors that negatively affect work productivity. Addressing these issues and striving to improve productivity through health management and the provision of an adequate workplace environment are crucial.

Evaluations using the WFun scale are conducted based on scores. To measure the degree of an employee's work impairment, the impact on job performance is evaluated and classified into the categories of "no issue," "mild," "moderate," and "severe." “No issue” indicates a state where no functional impairments are sensed, and duties are performed normally. “Mild” refers to sensing minor difficulties in performing work duties, but without any major impact on overall performance. “Moderate” describes experiencing clear difficulties in performing work, with a noticeable impact on performance. “Severe” indicates experiencing serious difficulties in carrying out work and a significant drop in performance.

The results of this survey for both before and after the transition to ABW as composition ratios for the 238 respondents in accordance with this scale, show there were some slight changes. “Severe” fell from 4% to 2% and “moderate” increased from 14% to 16%. Although there was no change in the overall percentage of those whose job performance was affected, the decrease in the "severe" category indicates there may have been a slight improvement.

5. Effects verification based on a measurement study

An employee's psychological and physiological condition has a significant impact on their performance and satisfaction when working in the office. Psychological condition includes elements such as stress, motivation and emotions. Physiological condition indicates the quality of sleep, level of fatigue, and health condition. Additionally, environmental conditions (room temperature, humidity, brightness, noise, etc.) also affect these conditions and influence the daily functioning and productivity of the workforce. It is important that these factors be appropriately measured and that the degree of their impact is understood.

Using sensors, it is possible to obtain objective, continuous data on physiological and environmental factors in an office environment. Wearable devices, for example, can be used to measure blinking intensity and intervals, gaze direction, and head movements, as well as to monitor activity such as walking and sleeping. These measurements help in determining employee stress levels and physical activity patterns. Environmental sensors, on the other hand, gather data on indoor illuminance, temperature, and noise levels, which are crucial for maintaining a comfortable and productive work environment.

Additionally, daily log questionnaires provide self-reported data suitable for evaluating psychological conditions and subjective health perceptions. These help us understand how employees respond to their workplace environment, and manage their personal emotions and stress levels.

In this research, we constructed an evaluation system using a wristwatch-type sensor device, an environmental sensor, and a daily log questionnaire and conducted actual measurements.

5.1 System overview

Figure 6 shows an overview of the system.

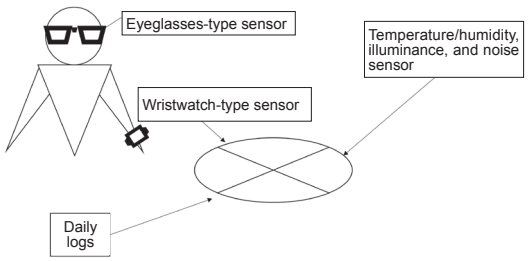


Fig. 6. System configuration

The wristwatch-type sensor device estimates calories burned during physical activities such as walking and running. It monitors these activities and estimates the calories they burn.

High-quality sleep is another critical aspect of health maintenance. This device estimates sleep patterns by analyzing

body movements and identifies sleep and wake times with a precision of ±15 minutes.

It can also measure pulse, a basic metric for health management. The device measures pulse rate using signals sent from a pulse wave sensor contained in the back of the main unit of the wristwatch-type sensor. Measurement is also possible when the subject is moving. However, intense exercise can sometimes make it difficult to obtain reliable data.

The system's conversation detection function uses a microphone in the main unit.

This test was conducted during the summer, when much work is performed while wearing short-sleeve shirts. This was to ensure that we would be able to detect everyday conversations at a volume above a certain level.

The eyeglasses-type sensor consists of a sensor module integrated with nose pads. Contained inside are sensors (equipped with a six-axis motion sensor made up of a three-point electrooculography sensor, a three-axis acceleration sensor and a three-axis gyro sensor; used to measure the wearer's eye and body movements), wireless components, a battery, and other modules. The weight of the entire frame is around 20g, with the sensor module segment approximately 6g, so there is no significant imbalance in weight during everyday life. When fully charged, the sensor can be used continuously for up to roughly 24 hours (or up to roughly 11 hours when the gyro sensor is used). For day-to-day use, subjects were instructed to charge the sensors next to their pillows while sleeping.

The sensor was controlled via an application installed on a smartphone at the beginning and end of work. After the application was started, data was recorded automatically.

The environmental sensor measures indoor temperature, humidity and noise levels automatically after installation, without requiring further operation. We installed these sensors on subjects' desks at home and at their workplaces and asked subjects to install a data logger that automatically records temperature and humidity on their desk at home and in their bedroom (near their pillow). We made sensor installation locations the same for both before and after the transition to ABW for comparison purposes.

5.2 Sample evaluation of work styles and productivity in office work before and after renovation

Figure 7 shows changes in work styles prior to and after the renovation. From office work to work from home (WFH), work styles are varied in nature. Regarding times subjects went to sleep and woke up and started and ended work, there appeared to be no major changes after construction of the new building was completed. Figure 8 shows the results of blinking measurements taken by the eyeglasses-type sensor. No meaningful differences after the renovation were found.

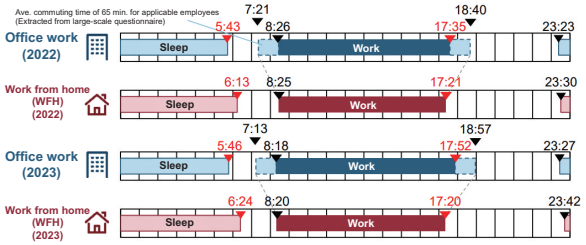


Fig. 7. Examples of working conditions before and after the renovation

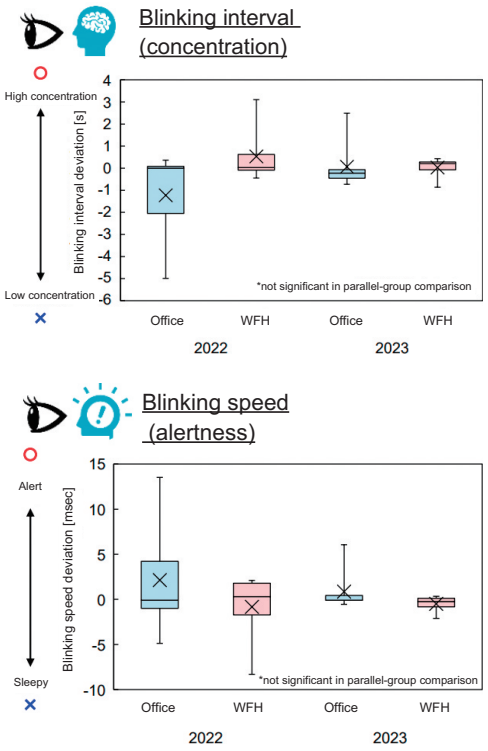
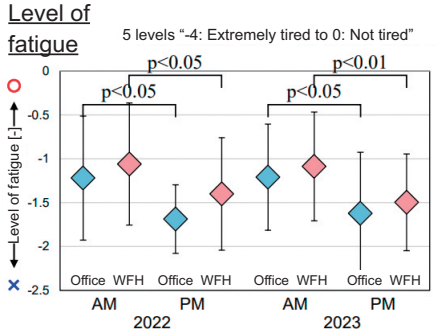


Fig. 8. Changes in blinking metrics on office work days and work from home days

Looking at productivity in office work, no meaningful difference was found in surveys administered after the renovation either. Trends are similar between both, such as increased fatigue and decreased alertness and concentration in the afternoon, as shown in figure 9. However, with respect to temperature sensation, while there was a meaningful shift toward warm sensations in the afternoon prior to the renovation, responses for both the morning and afternoon veered towards the neutral following the renovation. This suggests that the increased flexibility in choosing workspaces post-renovation may have allowed employees to select locations that better suited their thermal preferences.



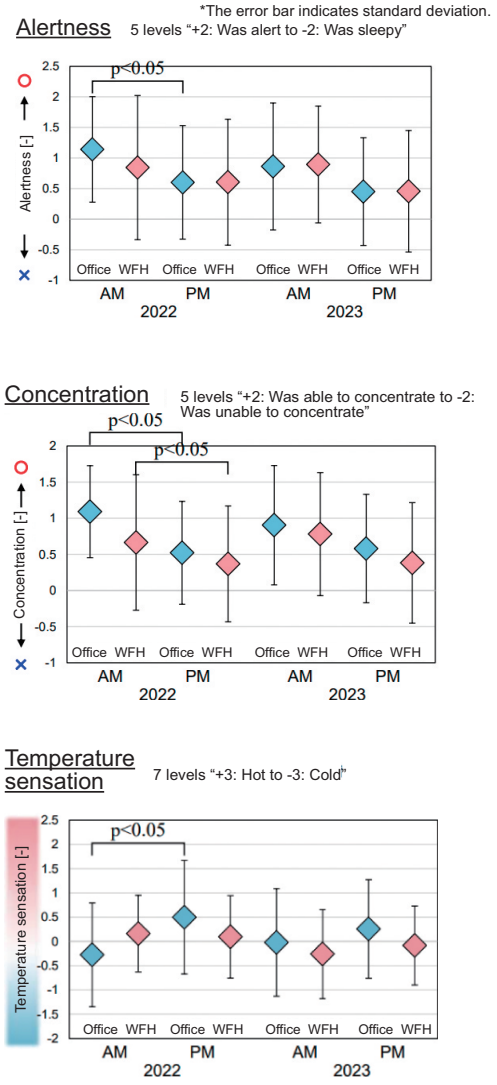


Fig. 9. Productivity of office work and work from home (before and after renovation)

6. Conclusions

We assumed that half of the respondents in this survey were 50 years of age or older. Given the increasing age of employees in the workplace, it is not uncommon to find workplaces where most employees are over 50. As generational composition will likely continue to shift in the future as well, there will be a need to keep on exploring opportunities for creating sustainable workplace environments that cater to future generations.

The effects of transitioning to ABW in terms of satisfaction with the office environment were verified using multiple criteria. These assessments suggest that such a transition may contribute to creating a more conducive work environment for office employees. However, no significant impact on the productivity or health of office workers was observed. Over time, as office workers continue to operate in an environment they find highly satisfactory and they become accustomed to ABW, we may see positive effects emerge. Further monitoring will be crucial. It is hoped that this follow-up survey will help maintain workplace vitality over the long term and promote productivity and innovation throughout the organization. We hope some insight was provided by this survey.

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