

Independent Design of the Legalization Office by Applying Activity-Based Flexible Office Concepts

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Abstract

The preliminary study found some employee complaints in the current legalization office. Precisely 46.67% complained about the inadequate facilities; 23.28% protested about the uncomfortable office design; 14.81% mentioned the unpleasable physical work environment; 33.33% complained about ineffective communication. This situation affected the loss of work productivity in legalizing many substantial documents given an inflexible office design that did not satisfy the user criteria. Thus, it is significant to improve or develop the office ergonomically by using the flexibility concept approach. The objective of this study is to design the Legalization Office with the Activity-based Flexible Office Concept and ergonomic principles. These concepts focus on work activities and flexibility for users to determine where, when, and how to get the work done as well as the comfort of work as a basic principle in design. The axiomatic design method was applied to find some design parameters of the office with the mapping process from functional requirements and customer attributes. The survey was conducted to identify the user requirements and validate the design parameters by using hypothesis testing. The result of this study is a flexible Legalization Office design with 27 items of valid design parameters to meet the user needs and it is more suitable than the current office at a 5% significance level.

Keywords

Activity-based Flexible Office (A-FO), Axiomatic Design, Design Parameter, and Legalization Office.

1. Introduction

The Legalization Office is a workplace for legalizing some crucial documents by a Notary. According to Kie (2007), a notary is a person authorized to perform certain legal formalities as a public need for someone with reliable and trustworthy information as evidenced by signatures and stamps as impartial and trustworthy evidence in maintaining the confidentiality for making an agreement. This task required assistance to type, review, and validate the document, and receive and check the online document.

The current preliminary study found that 59% of the office used a Small Open-plan office, which according to Danielsson and Bodin (2008) is defined as a small room containing 4 to 9 employees in one group so as to cause low interaction among other groups. Furthermore, this study identified that as much as 33.33% of users complained about the ineffective communication, which affected the productivity at work (Clampitt and Downs 1993), 46.67% of users also protested about inadequate facilities, 23.28% of users found the uncomfortable design of the workplace, 14.81% of users experienced an unpleasant physical work environment as well. According to Tarcan et al. (2004), the facilities of the workplace should be able to achieve higher employee satisfaction because it is significantly related to employee and organizational performance levels. This preliminary study also found that 13.51% of users complained about the narrow space that disrupts their work performances. This condition indicated the inflexible office design as shown by the fact that as much as 51.85% of users needed a more comfortable room.

A flexible and comfortable workplace is significant to work development as a way to contribute to the use of space and facilities efficiently. Van Der Voordt (2004) mentioned that having different types of workspace to carry out the specific work will increase performance and degree of sustainability because the employee can occupy a certain room that suits the type of work. Activity-based Flexible Office (A-FO) is a flexible office that focuses on human activities (Rolfö 2018). This office model allows employees to determine where, when, and how to do their work (Appel-Meulenbroek et al. 2011). A more open physical form of the office increases the level of socialization and

communication among colleagues so that it can provide functional support and better psychosocial and psychological impacts (Morrison and Macky 2017).

The objective of this study is to design the Legalization Office ergonomically based on the Activity-based Flexible Office Concept (A-FO) to meet the user requirements.

2. Methodology

2.1 Survey

An online survey was conducted to evaluate the current office conditions by using the A-FO questionnaire encompassing room layout, acoustics, interior design, mental demands, privacy, communication, interpersonal relationships, demographics, work environment satisfaction, and perceived level of performance parameters (Rolfö 2018) as a way to identify which attributes are required by customers using the developed open questionnaire. These questionnaires were distributed to 27 male and female respondents, who have experienced working in legalization activities. Their age ranges between 22 to 56 years old. Then, an interview was conducted as a follow-up to the survey result.

2.2 Developing the Conceptual Design of Legalization Office

Axiomatic Design Method was applied as a framework to build the design parameter (DP) by mapping process from Functional Requirements (FR) and Customer Attributes (CA). This framework explains the design method to map from "what we want to achieve" and "how to achieve it" (Durmusoglu and Kulak 2008, Kim 2014). Subsequently, results of the A-FO questionnaire and the A-FO Conceptual Model by L.V. Rolfö (2018) were used to determine the FR for fulfilling the CA. The zigzag method between domains to domains and decomposing the FR into a lower set of the DP that satisfied the FR were developed (Durmusoglu and Kulak 2008).

Anthropometric data were implemented to design the office, which consisted of Sitting Height (SH), Shoulder Breadth (SB), Buttock Popliteal Depth (BPD), Sitting Elbow Height (SEH), Hand Length (HL), Lower Arm Length (LAL), Popliteal Height (PH), Forward Grip Reach (FGR), Span (S), Elbow Spans (ES), Vertical Grip Reach (VGR), Shoulder Height (SH), and Knee Height (KH).

2.3 Statistical Analysis

Reliability testing was conducted to determine the consistency of sample data based on the Cronbach Alpha Coefficient with a minimum value of the test of 70 for acceptable criteria (Carmines and Zeller 1979, Nunnally and Bernstein 1994, Suyanto 2009).

Meanwhile, statistical non-parametric test by applying the Binomial Sign Test for two dependent samples (Sheskin 2004) was done to decide whether or not the proposed design meets the user requirement with a 5% significance level.

3. Result and Discussion

3.1 Analysis of Office based on User Complaints

Table 1 presents the result of the A-FO questionnaire and the interview. The first category produced 18% to 22% of employee complaints related to uncomfortable workbenches, such as the inadequate workbench function and lack of separation panel for private area. This condition implies that the workbench has no space for processing many substantial documents simultaneously. Therefore, the employees experienced difficulties to complete the tasks efficiently. In addition, as much as 20% to 33% of employees were dissatisfied with the second category since they had no appropriate facilities to work.

The third category denotes the extremely narrow reception area to meet the client and as a result, they were forced to wait in the same room with other employees. As much as 18% of employees experienced some problems to keep working and maintaining document confidentiality. On the fourth category, as much as 19% of were dissatisfied with the office since it did not provide them with sufficient spaces for moving freely. Consequently, the staff could not do work collaboratively.

The workspace was considered uncomfortable as indicated by the fact that as much as 17% to 29% of employee complaints were related to the physical work environment, such as being too noisy, too bright, as well as too hot. This condition is presented in the fifth category, which revealed the employee difficulties to maintain their focus at work, which thus decreased the work effectiveness. The sixth category revealed that as much as 20% of employees experienced an unaesthetic impression of office design, which affected their comfort at work because the office ambient has visually become more cramped.

Table 1. Perceived complaints

| Categories | A-FO Questionnaire | | Interview | |
|---|---|---------------|-----------|--------------------------------|
| | Aspect | %Dissatisfied | %Answered | Statement |
| Uncomfortable Workbench | Current workbench function | 18% | 14% | Uncomfortable workbench |
| | Privacy with separation panels around workplace | 20% | 5% | Lack of space on the workbench |
| | Possibility to retreat to private areas | 22% | 11% | Poor room grouping |
| Lack of Supporting Facilities | Access to equipment to perform work | 33% | 14% | Lack of supporting facilities |
| | Storage space | 22% | | |
| Lack of Reception Area | Size of reception room | 18% | 12% | Lack of reception area |
| Lack of Space to Move for Working Collaboratively | Distance between work tables | 19% | 9% | Lack of space to move |
| Uncomfortable Workspace | Background noise heard from workstation | 29% | 7% | Vehicle noise |
| | Conversation volume heard from workstation | 25% | - | - |
| | Lighting | 17% | | |
| | Visual comfort (glare, shade, etc.) | 21% | 5% | Poor lighting |
| | Possibility to view the outdoors | 22% | - | - |
| | Room temperature | 23% | 4% | Poor room temperature |
| Unaesthetic Design | Working room aesthetics | 20% | 1% | Poor air circulation |
| | | | 14% | Feels cramped |

3.2 Analysis of Customer Attributes (CA)

Results of the identified customer attributes are shown in Table 2. These attributed include: Adequate Facilities (CA 1), Comfortable Workspace (CA 2), and Good Communication (CA 3). CA 1 was required to reduce improper facilities, such as a workbench, supporting facilities, and reception area. This condition was denoted by the fact that as much as 46.67% of users needed some improvements to facilitate task completion. This way is expected to increase the efficiency of work. Meanwhile, CA 2 was needed to alleviate discomfort in doing the task, as revealed that as much as 43.33% of users proposed a refinement in the office design, especially on the need to design more interesting and effective workspace and layout as an attempt to maintain their focus at work. Then, CA 3 indicated a mandatory

development. This category implied that the users wanted swift interaction between colleagues to discuss problems at work as a way to create effective communication.

Table 2. Customer attributes (CA)

| Perceived Complaints | User Need | Customer Attributes | (%) |
|---|--------------------------------------|------------------------------|--------|
| Uncomfortable Workbench | Improving primary facility | Adequate Facilities (CA 1) | 46.67% |
| | Expanding workplace | | |
| | Room optimization | | |
| | Sorting out working room | | |
| Lack of Supporting Facilities | More supporting facilities | Adequate Facilities (CA 1) | 46.67% |
| | Improving office tools | | |
| | Internet Access | | |
| Lack of Reception Area | Expanding the reception area | Comfortable Workspace (CA 2) | 43.33% |
| Uncomfortable Workspace | Comfortable workspace | | |
| | Adequate air circulation | | |
| Unaesthetic Design | Lower room temperature | Comfortable Workspace (CA 2) | 43.33% |
| | Improving architectural design | | |
| Lack of Space to Move for Working Collaboratively | More unique offices | Good Communication (CA 3) | 10.00% |
| | Improving communication and teamwork | | |

3.3 Analysis of The Proposed Office Design

a) Analysis of Design Parameter for Adequate Facilities (CA 1)

Figure 1 shows the result of the mapping process from FR 1: improving productivity to DP 1: completing office facilities for satisfying the CA 1. This design consists of the use of the 14" Screen Laptop with 2.6 GHz Processor, 4 GB DDR4 RAM, 1 TB Hard Disk Drive, 36Whrs Battery, and Wi-Fi connectivity adapter (DP 1.1.1). The specification was applied to ensure efficient, flexible, and comfortable work performance, such as typing, reviewing, and checking the document (FR 1.1.1). This specification is also supported by the use of some workbenches for various settings of office areas to support different activities, including collaborative work and private work as an option for the office users to choose the suitable space for work (Appel-Meulenbroek et al. 2011, Appel-Meulenbroek et al. 2015, Wohlers and Hertel 2017) and stimulate the improvement of the interpersonal relationships through various acoustic zones and adjacent workstations (Rolfö 2018). The dimension of these facilities is 164 cm in lengths, 85 cm in widths, 84 cm in heights with a drawer on the adjacent workspace area (DP 1.1.2.1) and another room with a partition screen size is 215x215 cm square (DP 1.1.2.2) for providing an appropriate working area for employees in processing digital documents, locating some physical documents orderly, supporting the collaborative work efficiently (FR 1.1.2.1), as well as validating document (FR 1.1.2.2) for the notary works. Another table with 84 cm in lengths, 45 cm in widths, and 84 cm in heights placed on the back-up rooms with the size of 85x135 cm square with 128 cm heights partition screen (DP 1.1.3) was used to provide adequate space for the employees to withdraw to a private space for increasing their focus at work and reducing distraction, which was in line with (FR 1.1.3) (Rolfö 2018). On the contrary, a table of 84 cm in lengths, 85 cm in widths, and 84 cm in heights at the room with partition screen size of 135x215 cm square (DP 1.1.4) was made available for staff and clients to discuss and review the necessary documents effectively and privately (DP 1.1.4). These workbenches are also facilitated by the ergonomic adjustable chair with a backrest and armrest (DP 1.1.5) for every office user to seat comfortably and prevent early fatigue (FR 1.1.5).

Supporting facilities are a compulsory requirement for an efficient legalization office. These facilities include the storage room with a multi-level iron rack as tall as the office room (DP 1.2.1.1) and a small folding ladder (DP 1.2.1.2) as part of the Notary Protocol for storing the entire authentic document in the office (FR 1.2.1.1) and supporting the employees to reach the highest shelves more easily (FR 1.2.1.2). A storage room with 200 cm height storage racks and organizer box (DP 1.2.2) was also provided to store the office supplies efficiently (FR 1.2.2). Some equipment is also required to support the office, which includes the printer and scanner machine, a photocopy machine, a telephone-fax device, the typewriter, and the document shelf (DP 1.2.3) for supporting the employee activities in completing the substantial documents efficiently (FR 1.2.3). In addition, the wireless internet connection (DP 1.2.4) was also made

available for the employees since they need a reliable and fast connection to access some required documents (FR 1.2.4).

The reception area is also crucial for the legalization office. The standing reception desk of 83 cm in lengths, 45 cm in widths, and 103 cm in heights near the entryway (DP 1.3.1) was placed for receiving guests who would administer a case (FR 1.3.1). On the opposite were a sofa and table (DP 1.3.2) arranged for the guests to sit and wait comfortably (FR 1.3.2). The mini pantry with drink dispenser, kitchenware, and kitchen set (DP 1.3.3) on the corner of the reception area was installed to make an instant dish for the employees and clients (FR 1.3.3). Furthermore, the restroom included a toilet and ablution area with a praying room (DP 1.3.4) for the office users to relax (FR 1.3.4).

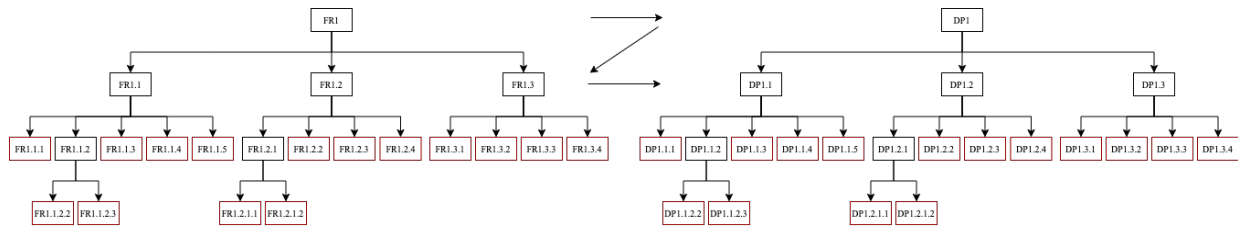


Figure 1. Mapping process of design parameter for CA 1

b) Analysis of Design Parameter for Comfortable Workspace (CA 2)

Figure 2 shows the results of the mapping process from FR 2: reducing physical strain and giving the impression of a spacious room to DP 2: ergonomic room with a minimalist style for satisfying CA 2. A comfortable office environment is very essential for increasing user satisfaction and reducing the physical and mental strains (Frontczak et al. 2012, Neupane et al., 2014) while the minimalist style can fulfill the required functions in the simplest possible form and acquire a higher satisfaction level (Nikolic and Vasilski 2017, Rolfö 2018). Thus, this office design consists of the use of air condition in every room (DP 2.1.1) for attaining a comfortable temperature in the range of 24°C to 27°C to create a non-fatiguing working space (FR 2.1.1) (Sutalaksana et al. 1979). The height of the office ceiling was made at 300 cm height (DP 2.1.2) to provide a relieving office room to ensure the smooth air circulation to maintain a fresh air (FR 2.1.2) (Susanti and Zetli 2017).

Good lighting is required for doing the legalization task as an essential step in mitigating human errors. Therefore, the LED fluorescent lamp 5000°K (DP 2.2.1) was installed to avoid shadows and provide uniform illumination (FR 2.2.1) for all rooms to inhibit eyes strain (FR 2.2). This condition is in line with the study conducted by Pracki (2020), Rong (2007), and Wang et al. (2017). Likewise, the large windows with shutters (DP 2.2.2) were set to alleviate glare as a form of artificial lighting to provide an outdoor view for users, so that they will work comfortably (FR 2.2.2). Moreover, the use of the glass wall partition among rooms (DP 2.2.3) can reduce shadows and increase a spacious impression for workers to create a more effective condition in completing a task (FR 2.2.3). The natural white colors (R = 238, G = 236, B = 229) of walls and ceiling (DP 2.2.4) create a roomy atmosphere (FR 2.2.4), an impression that will heighten passion at work to perform their tasks. This color design is relevant to Kwaliek (1996) studies. On the same fashion, the use of vinyl tile woods (DP 2.2.5) can reduce the reflection of the light from the floor (FR 2.2.5) because this tile can absorb light.

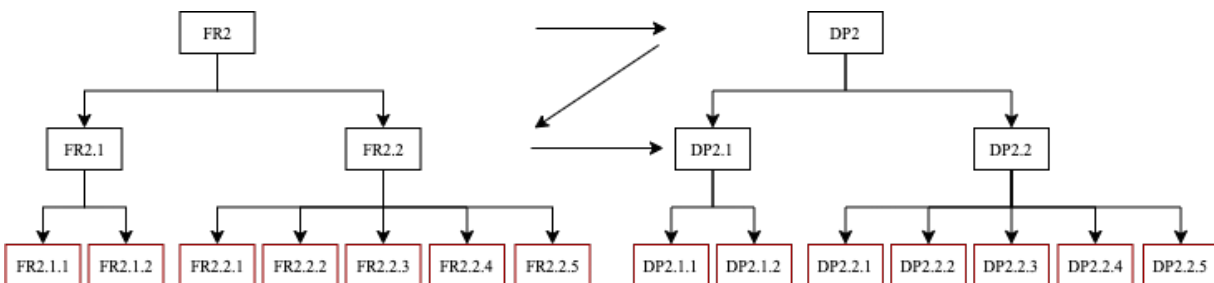


Figure 2. Mapping process of design parameter for CA 2

c) Analysis of Design Parameter for Good Communication (CA 3)

The results of mapping process from FR 3: maximizing work efficiency to DP 3: implementing flexible working for satisfying CA 3 is shown in Figure 3. This working style requires the clearance between facilities (DP 3.1) to ease the movement of the office user for doing work collaboration more efficiently (FR 3.1). Correspondingly, the communication between team members will be improved since the difficulties (Rolfö 2018) that led to a higher mental working condition due to more planning, movement, set-up time, limited access to work equipment, as well as difficulties in finding suitable colleagues and workplaces (Been et al. 2015, Van Der Voordt 2004) were well handled. Thus, the office requires some policies to maintain the office functionality (Gerdenitsch et al. 2017). The clean desk policy (DP 3.2.1) is implemented for clearing the workstation after use for ensuring the availability of workstations and the flexibility of the entire system (FR 3.2.1), as revealed by Rolfö (2018) studies. In addition, the implementation of the speech policy (DP 3.2.2) will regulate the noise level in a certain area (FR 3.2.2). This policy includes the requirement to produce a low speech level for backup rooms and a normal speech level for other rooms to prevent user dissatisfaction (Morrison and Macky 2017) and decreased performance (Jahncke et al. 2013) produced by noise and lack of auditory privacy. Additionally, the autonomy that gives the employees freedom to choose when, where, and how work is done (Wohlers and Hertel 2017) requires an efficient information related to work updates for every employee (FR 3.3). Thus, a work monitoring application is implemented in the office (DP 3.3).

Lastly, training (DP 3.4) was scheduled to accelerate the adaptation process for the employees to understand the forms and policies of the re-designed office and avoid miss-communication (FR 3.4) This training is in line with the study by Kotter (1995) for urging the head of the organization to develop a shared commitment to reform and act as a role model (Haynes 2008) to provide sufficient changes in organizational culture to prevent the failed implementation of A-FO.

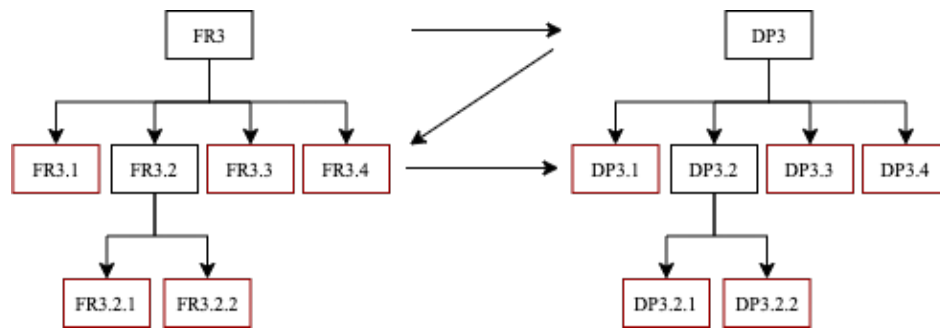


Figure 3. Mapping process of design parameter for CA 3

3.4 Design Concept of The Legalization Office

As shown in the following images, Figure 4 are the reception area and discussion room. Figure 5 shows the notary room, mini pantry and restroom. Furthermore, Figure 6 shows the working area that consists of adjacent workspace area, back-up rooms, and storage room.

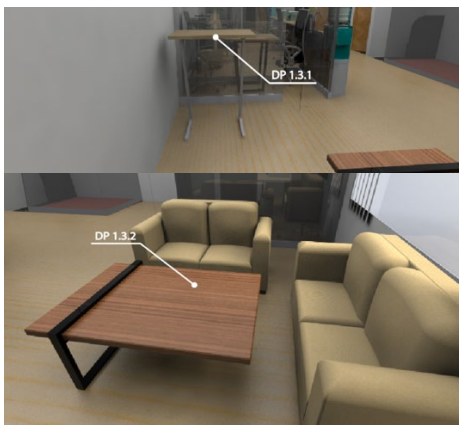


Figure 4. Reception area (left), discussion room (right)



Figure 5. Notary room (left), mini pantry and restroom (right)

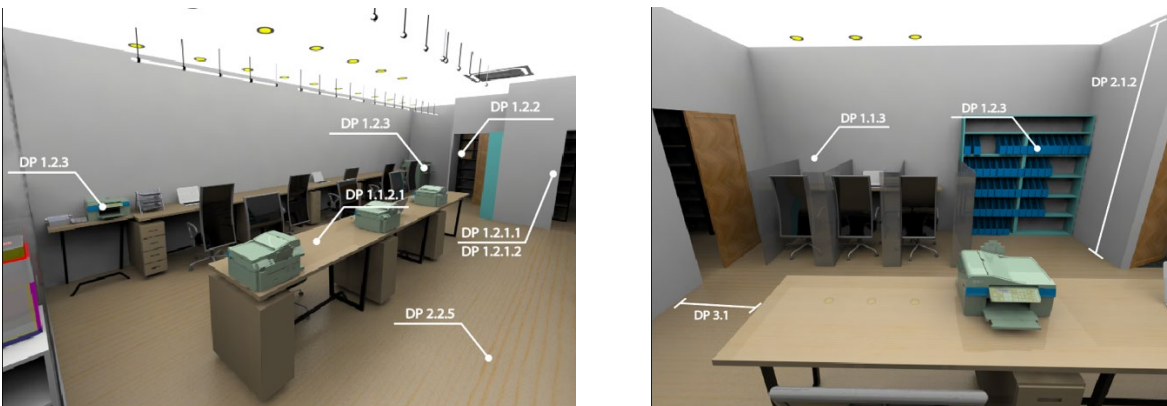


Figure 6. Working area (adjacent workspace area, back-up rooms, and storage room)

3.5 Statistical Analysis

The results of the reliability testing found that the scores of Cronbach Alpha Coefficient were .795, which was classified as reliable and consistent. This result means that the collected data are valid for design use.

Table 3. The results of Binomial Sign Test

| | CA1 | CA 2 | CA 3 |
|------------------------------|------|------|------|
| Exact Sig. (2-Tailed) | .000 | .000 | .001 |

Table 3 presents the results of the Binomial Sign Test with Sig. 2-Tailed at 5% significance level for each customer attributes, with the decision of rejecting a null hypothesis ($H_0: \pi \leq .50$). This result indicates that the developed concept design is valid to satisfy the user requirements for more adequate facilities, more comfortable workspace, and better communication.

4. Conclusion

This study concludes the following points:

1. The design attributes required by the customers for the flexible Legalization Office are adequate facilities, comfortable workspace, and good communication.

2. The valid independent design parameters for the Legalization Office to satisfy design attributes at 5% of significance level encompasses the use of laptops (DP 1.1.1: 14 Screen, 2.6 GHz Processor, 4 GB DDR4 RAM, 1 TB Hard Disk Drive, 36WHrs Battery, and Wi-Fi connectivity adapter), the comfortable workbench (DP 1.1.2.1: 164 cm in lengths, 85 cm in widths, 84 cm in heights with a drawer on the adjacent workspace area; DP 1.1.2.2: 164 cm in lengths, 85 cm in widths, 84 cm in heights with a drawer on a room with a partition screen size is 215x215 cm square; DP 1.1.3: 84 cm in lengths, 45 cm in widths, and 84 cm in heights placed on the back-up rooms with the size of 85x135 cm square with 128 cm heights partition screen; DP 1.1.4: 84 cm in lengths, 85 cm in widths, and 84 cm in heights at the room with partition screen size of 135x215 cm square; and DP 1.1.5: ergonomic adjustable chair with a backrest and armrest), the adequate supporting facilities (DP 1.2.1.1: storage room with a multi-level iron rack as height as office room; DP 1.2.1.2: a small folding ladder for the storage room; DP 1.2.2: storage room with 200 cm height storage racks and organizer box; DP 1.2.3: printer and scanner machine, a photocopy machine, a telephone-fax device, the typewriter, and the document shelf; and DP 1.1.4: wireless internet connection), comfortable reception area (DP 1.3.1: standing reception desk with size 83 cm lengths by 45 cm in widths and 103 cm in heights near the entryway; DP 1.3.2: sofa and table; DP 1.3.3: mini pantry with drink dispenser, kitchenware, and kitchen set; DP 1.3.4: restroom), the use of air condition (DP 2.1.1), the 300 cm heights of office ceiling (DP 2.1.2), the use of LED fluorescent (DP 2.2.1), the use of the large windows with shutters (DP 2.2.2), the use of glass wall partition (DP 2.2.3), natural white colors of wall and ceiling (DP 2.2.4), the use of vinyl tile woods (DP 2.2.5), a sufficient clearance between facilities (DP 3.1), the implementation of clean desk (DP 3.2.1) and speech (DP 3.2.2) policy, the use of a work monitoring application (DP 3.3), and training (DP 3.4).

References

- Appel-Meulenbroek, R., Janssen, I., and Groenen, P., An end-user's perspective on activity-based office concepts, *Journal of Corporate Real Estate*, vol. 13, no. 2, pp. 122–135, 2011.
- Appel-Meulenbroek, R., Kemperman, A., Kleijn, M., and Hendriks, E., To use or not to use: Which type of property should you choose? Predicting the use of activity based offices, *Journal of Property Investment and Financ*, vol. 33, no. 4, pp. 320–336, 2015.
- Been, I. D., Beijer, M., and Hollander, D. D., How to cope with dilemmas in activity based work environments: results from user-centred research, *Proceedings of the 14th h EuroFM Research Symposium*, Glasgow, UK, June 1–3, 2015, pp. 1-10.
- Carmines, E. G., and Zeller, R. A., *Reliability and validity assessment*, 17th Edition, Sage publications, Thousand Oaks, CA, 1979.
- Clampitt, P. G., and Downs, C. W., Employee perceptions of the relationship between communication and productivity: A field study, *The Journal of Business Communication*, vol. 30, no. 1, pp. 5–28, 1993.
- Danielsson, B. C., and Bodin, L., Office type in relation to health, well-being, and job satisfaction among employees, *Environment and Behavior*, vol. 40, no. 5, pp. 636–668, 2008.
- Durmusoglu, M. B., and Kulak, O., A methodology for the design of office cells using axiomatic design principles, *Omega*, vol. 36, no. 4, pp. 633–652, 2008.
- Frontczak, M., Schiavon, S., Goins, J., Arens, E., Zhang, H., and Wargocki, P., Quantitative relationships between occupant satisfaction and satisfaction aspects of indoor environmental quality and building design, *Indoor Air*, vol. 22, no. 2, pp. 119–131, 2012.
- Gerdenitsch, C., Korunka, C., and Hertel, G., The effects of an activity-based flexible office redesign on office workers: A longitudinal study, *Environment and Behavior*, 2017.
- Haynes, B. P., The impact of office layout on productivity, *Journal of Facilities Management*, vol. 6, no. 3, pp. 189–201, 2008.
- Jahncke, H., Hongisto, V., and Virjonen, P., Cognitive performance during irrelevant speech: Effects of speech intelligibility and office-task characteristics, *Applied Acoustics*, vol. 74 no. 3, pp. 307–316, 2013.
- Kie, T. T., *Studi Notariat dan Serba-Serbi Praktek Notaris*, 1st Edition, Ichtar Baru Van Hoeve, Jakarta, 2007.
- Kim, S. G., *Axiomatic Design BT - CIRP Encyclopedia of Production Engineering (L. Laperrrière & G. Reinhart (eds.))*, 1th Edition, Springer, Heidelberg, 2014.
- Kotter, J. P., *Leading change: Why transformation efforts fail*, Available: <https://hbr.org/1995/05/leading-change-why-transformation-efforts-fail-2>.
- Kwallek, N., Office wall color: An assessment of spaciousness and preference, *Perceptual and Motor Skills*, vol. 85, no. 1, pp. 49–50, 1996.
- Morrison, R. L., and Macky, K. A., The demands and resources arising from shared office spaces, *Applied Ergonomics*, vol. 60, pp. 103–115, 2017.

- Neupane, S., Virtanen, P., Luukkaala, T., Siukola, A., and Nygård, C. H., A four-year follow-up study of physical working conditions and perceived mental and physical strain among food industry workers, *Applied Ergonomics*, vol. 45, no. 3, pp. 586–591, 2014.
- Nikolic, M., and Vasilski, D., Minimalism in contemporary architecture as one of the most usable aesthetically-functional patterns, *Facta Universitatis - Series: Architecture and Civil Engineering*, vol. 15, no. 3, pp. 333–345, 2017.
- Nunnally, J. C., and Bernstein, I. H., *Psychological theory*, 3rd Edition, McGraw-Hill, New York, 1994.
- Pracki, P., The impact of room and luminaire characteristics on general lighting in interiors, *Bulletin of the Polish Academy of Sciences: Technical Sciences*, vol. 68, no. 3, pp. 447–457, 2020.
- Rolfö, L. V., Activity-based Flexible Office work environments : Design and implementation processes and outcomes, *Division of Ergonomics*, vol. *Doctor of*, 2018.
- Rong, B., Evaluation of LED application in general lighting, *Optical Engineering*, vol. 46, no. 7, pp. 074002, 2007.
- Sheskin, D. J., *Handbook of Parametric and Nonparametric Statistical Procedures*, 3rd Edition, CRC Press, US, 2004.
- Susanti, L., and Zetli, S., Penyusunan Kriteria Rumah Tinggal Berkonsep Ergo-Ekologi Dalam Upaya Peningkatan Kenyamanan Termal Penghuni, *Jurnal Optimasi Sistem Industri*, vol. 15, no. 2, pp. 155, 2017.
- Sutalaksana, I. Z., Anggawisastra, R., and Tjakraatmadja, J. H., *Teknik Tata Cara Kerja*, Departemen Teknik Industri ITB, Bandung, 1979.
- Suyanto, S., *Pedoman Analisis Data dengan SPSS*, 3rd Edition, Graha Ilmu, Yogyakarta, 2009.
- Tarcan, E., Varol, E. S., and Ates, M., A qualitative study of facilities and their environmental performance, *Management of Environmental Quality: An International Journal*, vol. 15, no. 2, pp. 154–173, 2004.
- Van Der Voordt, T. J. M., Productivity and employee satisfaction in flexible workplaces, *Journal of Corporate Real Estate*, vol. 6, no. 2, pp. 133–148, 2004.
- Wang, Q., Xu, H., Zhang, F., and Wang, Z., Influence of color temperature on comfort and preference for LED indoor lighting, *Optik*, vol. 129, pp. 21–29, 2017.
- Wohlens, C., and Hertel, G., Choosing where to work at work—towards a theoretical model of benefits and risks of activity-based flexible offices, *Ergonomics*, vol. 60, no. 4, pp. 467–486, 2017.