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Analysis of workplace facilities in the Remuneration and Industrial Relations (RHI) Department using anthropometric approach

Ahmad Dani Mursyid*, Nadia Fasa, Billy Nugraha

Universitas Singaperbangsa, Karawang Indonesia

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ABSTRACT

In the industrial landscape, employee welfare plays a pivotal role in influencing company productivity and overall employee satisfaction. A crucial aspect that shapes employee welfare is the quality of the work facilities provided by the company. The incorporation of ergonomic work facilities can significantly amplify work comfort and safety, thereby mitigating the risks associated with work-related injuries or health issues. This research seeks to assess the ergonomic aspects of work facilities within a workspace by applying anthropometric principles. This methodology involves measuring various facets of the human body, encompassing shape, size, and strength, and utilizing these metrics to customize facilities to suit human requirements. Such an approach holds the potential to augment employee performance and alleviate symptoms associated with musculoskeletal disorders. The research findings highlight several dimensions of work facilities that do not align with the employees' body dimensions. Consequently, it is imperative to propose recommendations to the Remuneration and Industrial Relations Department of PT CCP, a private company in Indonesia, aimed at enhancing work facilities. These suggestions aim to realign the facilities with anthropometric dimensions meticulously designed by the author.

1. Introduction

In the industrial sector, employee welfare plays a pivotal role in influencing both company productivity and sustainability [1]. Workplace facilities provided by the company are a key determinant of employee welfare. The incorporation of ergonomic workplace facilities enhances work comfort and safety while reducing the risk of work-related injuries or health concerns [2]. Therefore, conducting an analysis of workplace facilities holds paramount importance to ensure that working conditions align with the physical characteristics of employees.

A workspace encompasses both physical and non-physical elements. Physical components include items such as tables, chairs, whiteboards, air conditioners, and other equipment that facilitate more streamlined work processes. Non-physical elements encompass the work environment, including lighting, noise levels, temperature, and other similar factors [3]. Among these elements, physical facilities wield the most substantial influence on work dynamics. Physical facilities extend beyond mere items in the workspace; they should conform to ergonomic principles to establish a comfortable working environment, ultimately enhancing employee performance [4].

This research assesses the condition of workplace facilities in office spaces to ascertain their ergonomic status, utilizing an anthropometric approach. Anthropometric methods entail measuring various aspects of the human body, encompassing shape, size, strength, and their application in designing human-centered facilities [5]. Employing anthropometric data in the analysis of workplace facilities can assist companies in optimizing the design and layout of workspaces that cater to employees' physical requirements, mitigating discomfort, fatigue, and other potential risks of injury resulting from inadequate facilities.

For instance, a previous pertinent study by Nugraha et al. [6] aimed to design work aids and workplaces for shoe sole installation, employing Anthropometric methods to ensure safer, more comfortable, and healthier working postures. This design not only mitigates the risk of work-related accidents stemming from poor posture but also enhances work productivity. Another noteworthy study, conducted by Andhini [7], sought to analyze the suitability of table and chair sizes

*Corresponding author:
Email: ahmaddanimursyid09@gmail.com

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based on employee anthropometric measurements. The findings revealed a disparity between the dimensions of work chairs and employee anthropometric data, underscoring the significance of anthropometric analysis in designing ergonomic workplace facilities.

Another relevant study was conducted by Suarjana et al. [8]. The research results focused on assessing physiological burden through musculoskeletal complaints and subjective fatigue experienced by employees. This research provides recommendations for designing ergonomic work facilities, especially ergonomic work desks adapted to the anthropometric data of operators/participants. Designing work tools that are in harmony with employee anthropometric measurements can reduce musculoskeletal complaints and fatigue levels in employees.

Similar research was conducted by Ti and Nurwathi [9]. The condition of the cassava cutting machine at PD KTR Katineung Rasa in Sumedang, Indoesia, is fairly satisfactory; however, it does not adhere to ergonomic standards. This includes the absence of protective equipment on the cassava chopper machine, causing water from the cutter to splash onto the workers during operations. Additionally, the seat on the cassava machine is constructed from solid iron plates, leading to discomfort and complaints of pain when workers operate the machine for extended periods. Addressing these issues, an ergonomic cassava chopper was designed, employing anthropometric calculations that involved averaging values, calculating standard deviation, establishing upper and lower control limits, and determining percentiles.

Another similar study was undertaken by Destian and Achiraeniwati [10]. Their research focused on developing models of work tools utilizing anthropometric methods to minimize the risk of work-related accidents during the transportation of goods. The simulation results following the design of the hand lift demonstrated a decreased risk level, reducing the operator's risk to code 1 when moving goods. This reduction signifies that no corrective action is required.

Another study was carried out by Muhammad and Nuruddin [11]. Using the RULA and REBA analysis methods, they identified that the work position of kitchen staff falls within the moderate risk category for injury, necessitating immediate corrective action. The proposed solution involves redesigning the kitchen table based on anthropometric principles. Post-work posture simulations using the new facility design reveal acceptable posture categories with a low risk of injury.

Another relevant study was conducted by Hendrartoet al. [12]. The research results indicated that while the interior spaces at Cirebon City Hall met standard space requirements, they lacked anthropometric comfort. Applying anthropometric concepts in building design is anticipated to enhance comfort levels. Increased comfort can positively impact work quality, thus contributing to the improvement of the Cirebon City Government. Additionally, Iskandar and Hilman conducted a separate study [13], which proposed enhancing the work chair by adding a chair back and foam seat cushion based on previous observations.

Next, research was conducted by Destian and Achiraeniwati [14]. The aim of this research was to design work facilities using anthropometric methods to minimize work risks experienced by bale moving workers. The method used to measure work risk was the Ovako Working Analysis System with ErgoFellow Software tools and to determine operator complaints, the Nordic questionnaire Body Map was utilized.

Subsequently, another study was carried out by Fauzan et al. [15]. The research results revealed the necessity for developing dining tables that align with needs and desires, offering improvements in features, design, durability, and size to ensure long-term comfort during use.

Following this, research conducted by Muhammad and Nuruddin [16] indicated through RULA and REBA analyses that the posture adopted by cooks posed a moderate risk of injury, requiring immediate corrective action. The solution involved redesigning the kitchen table using an anthropometric approach. Simulations with the new work facility design placed the work posture within an acceptable category with a low risk of injury.

Lastly, Yudhistira et al. [17] aimed to design a new workplace by revamping workstations using the body posture method. Initial research using the Nordic Body Map (NBM) assessed pain levels in the back, buttocks, right and left elbow, right and left forearm. The research revealed a REBA score of 5, signifying a moderate risk level requiring improvement. Additionally, the QEC score depicted a worse situation, with an Exposure Level value of 52.3%. The research recommendation proposed designing a work system by remodeling tables and chairs at workstations using anthropometric measurements.

Among the previous relevant studies is the research conducted by Widodo and Setyawan [18]. The Nordic Body Map results in the line production department revealed numerous musculoskeletal complaints among shop workers due to workplace ergonomics. These findings necessitate further action, specifically the design of ergonomic chair work facilities based on anthropometric values.

Additionally, Suryatman and Linayah conducted a study [19] aimed at providing innovative initiatives and ideas for ergonomic table design tailored to users' needs and desires, especially during the ongoing pandemic. The approach used involved QFD and anthropometric suitability methods.

Similarly, Zulkarnain and Ridwan [20] focused their research on medical masks, emphasizing their increased necessity during the pandemic and the resultant rise in medical mask waste. To mitigate this issue, they designed a facility for processing medical mask waste using Ergonomic Function Deployment and implementing anthropometry in its measurements.

Moreover, another study was performed by Sinaga et al. [21]. This research aimed to design ergonomic tutorial table and chair facilities that cater to potential

users' needs. The design approach utilized 12 ergonomic principles, translating user needs into Ergonomics Function Deployment (EFD) to create a House of Quality (HOQ), complemented by an anthropometrically suitable design for tutorial tables and chairs based on the 5-95th percentile of student body dimensions.

Another relevant study was conducted by Azmi, Muhammad Arif, and Diki M Ramadani [22]. This study focused on grilling tools still commonly using square-shaped wire clamps that require manual fanning, consuming significant energy over extended periods. The research aimed to design a tool using an anthropometric approach to achieve ergonomic dimensions, equipped with four adjustable fans below the combustion chamber.

Another study was carried out by Azmi et al. [23], focusing on designing a coconut fiber peeling tool to aid the community and workers in daily activities. This tool aimed to replace the spear peeler, a commonly used but dangerous tool for peeling coconuts that poses a risk of injury. Moreover, Muis et al. [24] conducted a study combining QFD theory with Anthropometrics to derive optimal recommendations. Their approach, based on normality testing, data uniformity, and percentile measurements, resulted in the creation of the 'AutoAdjustable' table product, designed ergonomically, effectively, and safely.

Another relevant study was undertaken by Septyanda and Lestari [25], aiming to identify individual factors causing work fatigue among heavy equipment operators. The research revealed age, health status, and nutritional condition as contributing factors to work fatigue among these operators. Furthermore, a study conducted by Mindayani et al. [26] aimed to determine factors related to eye fatigue among tailors in Lubuk Alung District, Padang Pariaman Regency in 2021. This survey-analytic study observed that non-ergonomic work facilities contributed to eye fatigue, necessitating improvements. Lastly, research by Susetyo et al. [27] aimed to evaluate the ergonomics of the office work environment and its impact on health. Field observations and interviews were conducted, indicating that the comfort of chairs and work desks did not directly correlate with the employees' health.

Several studies strongly advocate for the significance of anthropometric analysis in designing ergonomic workplace facilities, particularly in PT CCP, one of the largest manufacturing industries. PT CCP, a state-owned company in the printing industry located in West Java, has been producing fertilizer since its establishment in 1997. As a subsidiary of Pupuk Indonesia, the largest fertilizer producer in Indonesia, the company comprises various departments, including the Remuneration and Industrial Relations Department, accommodating a large workforce. This highlights the necessity of comfortable workplace facilities to optimize employee performance. Offering ergonomic and comfortable physical facilities can positively influence work support, enhance employee productivity and welfare, and diminish the risk of injury due to inadequate physical conditions. These facilities encompass spatial dimensions, equipment, and inventory, ensuring adherence to ergonomic standards.

Distinguished by its use of a limited sample, consisting of three individuals from each work unit, this research aims for more efficient analysis by focusing on the specific criteria of the sampled employees. The approach includes qualitative techniques referring to predetermined indicators and parameters as a comparison to earlier facility analyses. Additionally, quantitative techniques are employed, involving the calculation of dimensions for work facilities, such as chairs and tables in the RHI department, to suit employee body dimensions.

Hence, this fieldwork involved conducting research applying ergonomics with an anthropometric approach in the Remuneration and Industrial Relations Department. Employing this approach, the author observed, analyzed, and assessed the suitability of existing workplace facilities based on employees' physical characteristics. The study also proposes recommendations for improvements aligned with the anthropometric approach for RHI department employees. The aim of this research is to contribute to enhancing employee welfare and productivity while minimizing the risks associated with injuries or health issues often linked with work in the Remuneration and Industrial Relations Department. The author's contribution lies in laying a solid foundation for companies to improve working conditions and ensure employee welfare, integral to achieving organizational goals.

2. Material and method

This section presents the methodology used in this research. First, the problem formulation is described (Section 2.1). Second, the researcher proposes to use an anthropometric approach to solve the problem that is the object of research (Section 2.2). Finally, researchers collected data using tools so that an analysis of the suitability between employee body dimensions and work facility dimensions could be carried out (Section 2.3).

2.1. Problem formulation

The research commenced by identifying problems at PT CCP. Subsequently, a comprehensive literature review was conducted, referencing various previous research journals. This step aimed to gather research references and establish the groundwork for the literature review. Following this, data collection took place through direct interviews with company representatives to gain an overview of the identified issues. The collected data underwent processing using theories from the book "Human Dimension & Interior Space" authored by Julius Panero and Martin Zelnik [28]. These theories were developed by three companies: PT Solo Abadi, Rupa-rupa sales market, and Ergonomic.co, providing recommendations that the

dimensions of workplace facilities must fall within a range of 5-10 cm in comparison to the dimensions of the human body. This range aims to achieve good posture and reduce musculoskeletal symptoms.

The approach towards anthropometry is based on a combination of these general guidelines and practical experience in designing ergonomic workspaces. The initial stage involved observing workplace facilities and employees within the Department of Remuneration and Industrial Relations. A single sample was selected from three available work units due to time limitations, choosing an employee with unique body dimensions and willingness to participate in the study. Data collection was carried out through photo documentation and dimensional measurements using the Measure application.

The measurements collected were categorized into samples of body dimensions, chair dimensions, and table dimensions utilized by employees. Subsequently, an analysis was conducted by comparing the dimensions of workplace facilities with the employees' body dimensions, utilizing an anthropometric indicator approach that aims for a range comparison of 5-10 cm between the dimensions of the human body and workplace facilities. This comparison yielded varying results between employee body dimensions and workplace facility dimensions for each sample.

Following the analysis, the dimensions of the workplace facilities were computed using anthropometric formulas or methods to ascertain their suitability with the employees' body dimensions, aligning with the anthropometric indicator approach.

2.2. Object of research

In this research, field observation techniques were employed to gather data samples of employee body dimensions alongside the dimensions of their work facilities, specifically chairs and tables. The following are three employee samples selected as objects in this research, visually represented in Fig. 1, Fig. 2, and Fig. 3. The work facilities used by employees, namely chairs and tables, can be seen in Fig. 4, Fig. 5, Fig. 6, and Fig. 7.

2.3. Data collection

The body part measured in this research is shown in Table 1. The results of measuring the body dimensions of employees at RHI PT CCP fertilizer can be seen in Appendices. Table 2 are the results of grouping data obtained from measurements using the Measure application. Table 3 and Table 4 are the results of measurements for chair and table.

Table 1.
Research object indicator parameters

ID	Body measured
D10	Dimensions of Shoulder Height in Sitting Position
D11	Dimensions of Elbow Height in Sitting Position
D14	Popliteal Length Dimensions
D16	Popliteal Height Dimensions
D18	Top Shoulder Width Dimensions
D19	Hip Width Dimensions
D24	Forward Hand Stretch Dimensions
D32	Dimensions Length of Hand to Side

Figure 1. Payroll unit

Figure 2. Payroll unit

Figure 3. Payroll unit

Figure 4. Chair 1

Figure 5. Chair 2

Figure 6. Table 1 [29]

Figure 7. Table 2 [29]

Table 2.
Employee body dimensions

No.	ID	Example 1	Example 2	Example 3
1	D10	68.58	61.41	71.35
2	D11	37.70	35.47	43.29
3	D14	41.96	39.55	45.64
4	D16	46.21	42.87	49.85
5	D18	50.86	38.12	41.25
6	D19	37.14	30.94	32.56
7	D24	58.69	56.89	61.76
8	D32	162.24	148.50	163.49

Table 3.
Employee chair dimensions

No	Component	Seat 1	Seat 2
1	Chair Back Height	48.51	60.07
2	Chair Seat Length	30.08	45.63
3	Chair Leg Height	41.24	49.78
4	Seat Back Width	40.75	49.21
5	Chair Seat Width	35.82	43.02

Table 4.
Employee table dimensions

No	Component	Table 1	Table 2
1	Table Height	55.08	53.51
2	Table Width	76.82	69.36
3	Table Length	182.50	157.52

Table 5.
Indicators of dimensional suitability analysis

No	Indicator	Value	Explanation
1	The dimensions of chairs and tables are smaller than the dimensions of the employee's body	<5-10cm	If the dimensions of the chair and table are less than 5-10 cm, then the chair and table are not suitable and adjustments need to be made.
2	The dimensions of the chair are close to the employee's body dimensions	5-10cm	If the chair dimensions are close to or within the 5 cm parameter, then the chair and table can be said to be suitable
3	The dimensions of chairs and tables are larger than the dimensions of the employee's body	> 5-10cm	If the dimensions of the chair and table have a difference of more than 5-10 cm, then the chair and table are not suitable and need to be adjusted.

3. Results and discussions

The table above concludes that the suitability indicator between chairs and tables and the employees' body dimensions falls within the range of 5 – 10 cm. It signifies that the chair and table sizes align with these body dimensions, presenting an ideal design that harmonizes the dimensions of the furniture with those of the employees. This indicator is formulated based on a blend of general guidelines and practical experience in crafting tailored ergonomic workspaces, in line with the ergonomic principles and theories outlined in the book 'Human Dimension & Interior Space' by Julius Panero and Martin Zelnik. This approach aims to plan customized, comfortable, and functional interior spaces that cater to the body dimensions of individuals and their associated work facilities.

In Table 6, Popliteal Length Dimension (D14) and Upper Shoulder Width Dimension (D18) do not align with the chair dimensions. However, the other dimensions correspond well with the body dimensions. On the other hand, comparing sample 1 with table 1, none of the body dimensions match the table dimensions.

In Table 7, In comparing sample 2 with chair 2, the upper shoulder width dimensions (D18) and hip width dimensions (D19) do not match the chair dimensions, while the rest of the body dimensions meet the chair dimensions. chair. Meanwhile, in the comparison between sample 2 and table 2, the Sitting Position Elbow Height dimensions (D11) and Front Arm Span Length dimensions (24) do not match the table dimensions and Arm Span Length dimensions. Hands to the Side (32) can be said to be correct. with table dimensions.

In Table 8, when comparing sample 3 with chair 2, the shoulder height in the sitting position (D10) and hip width (D19) dimensions do not correspond to the chair's dimensions, while the remaining body dimensions align with the chair. However, when comparing sample 3 with table 2, it can be observed that the body dimensions match the table's dimensions.

Table 6.
Body dimensions for sample 1 with chair 1

Dimensions	Example 1	Explanation	Seat 1
D10	**68.58**	Chair Back Height	**48 .51**
D14	**41.96**	Chair Seat Length	**30.08**
D16	46.21	Chair Leg Height	41.24
D18	**50.86**	Seat Back Width	**40.75**
D19	37.14	Chair Seat Width	35.82

Table 7.
Body dimensions for sample 1 with chair 1

Dimensions	Sample 2	Component	Seat 2
D10	61.41	Chair Back Height	60.07
D14	39.55	Chair Seat Length	45.63
D16	42.87	Chair Leg Height	49.78
D18	38.12	Seat Back Width	**49.21**
D19	30.94	Chair Seat Width	43.02

Table 8.
Body dimensions for sample 1 with chair 1

Dimensions	Sample 2	Component	Seat 2
D10	**71.35**	Chair Back Height	**60.07**
D14	45.64	Chair Seat Length	45.63
D16	49.85	Chair Leg Height	49.78
D18	41.25	Seat Back Width	49.21
D19	**32.56 _**	Chair Seat Width	**43.02**

Table 12.
Dimension from anthropometric formula (cm)

Dimensions	P5	P50	P95
D10	60.23	67.11	73.98
D11	33.42	38.82	44.22
D14	38.20	42.38	46.56
D16	41.64	46.31	50.98
D18	34.51	43.41	52.31
D19	29.24	33.55	37.86
D24	55.80	59.11	62.42
D32	141.03	153.12	169.25

After analyzing the comparative dimensions between employee body measurements and work facility dimensions, it's evident that many work facility dimensions still do not align with the employee body dimensions. Therefore, the author suggests recommending appropriate dimensional data using anthropometric formulas. The results are shown in Table 9.

4. Conclusions

The comparative analysis between the dimensions of work facilities and employee body measurements yielded the following results. In sample 1 (Payroll and HR Management sections), several dimensions such as shoulder height in sitting position (D10), elbow height (D11), popliteal length (D14), arm length when stretched forward (D24), and arm length when stretched to the side (D32) are not suitable. Adjustments to the dimensions of work facilities, particularly chairs and tables, are necessary to enhance employee performance and alleviate musculoskeletal disorders. In sample 2 (Industrial Relations section), dimensions like elbow height (D11), popliteal height (D16), upper shoulder width (D18), hip width (D19), and arm span length to the front (D24) do not align. Modifying work facility dimensions is crucial to improve employee performance and reduce musculoskeletal disorders. In sample 3 (Insurance and Employee Welfare section), dimensions such as shoulder height in sitting position (D10) and hip width (D19) are not suitable. Adjusting the dimensions of work facilities, especially chairs, is necessary to enhance employee performance and alleviate musculoskeletal disorders.

The proposed improvements in work facilities aim to reduce symptoms of Musculoskeletal Disorders, enhance productivity, and foster a more comfortable work environment. This involves arranging employee work facilities based on their body dimensions, altering work positions for increased comfort, and minimizing excessive workload to maintain overall health.

As a recommendation for future research, enhancing the factory's work system using anthropometry could be explored.

Declaration statement

Ahmad Dani Mursyid: **Conceptualization, Methodology, Writing-Original Draft**. Nadia Fasa: **Design, Creating product prototypes**, **Resources, Validation, Formal analysis**. Siti Aisyah: **Resources, Visualization, Investigation**, **Writing-Review & Editing.**

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The authors report there are no competing interests to declare.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article or its supplementary materials.

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