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COMPARISON ANALYSIS OF RULA SCORES ON IMPROVEMENT WORKPLACE DESIGN IN CONCRETE BRICK MANUFACTURING SMEs

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ABSTRACT

Paving block is constructions material usually used for form wall on building or construction jobs. Quality C dan D paving block manufacture on SMEs Scale in Tasilkmalaya Village does not have proper workplace design so that molder operator work in squat position. Squat position in manufacture paving block process is increasing RULA Score and ergonomic risk for musculoskeletal disorder (MSDs). In previous research, improvement has been applied to workplace, it has successfully increased productivity, but it is not sure can decrease ergonomic risk musculoskeletal disorder (MSDs) and RULA Score. This research aim to identify and compare the RULA Score before and after improvement. Analysis methods is used Rapid Upper Limb Assessment (RULA) with CATIA on moves element which has break down with Theblig methods. The result of research is workplace improvement has successfully decreased levels of ergonomic risk 43%.

Keywords: *Rapid Upper Limb Assessment*, RULA, *Workplace Design*

Introduction

Concrete brick is a building material that is used to reinforce walls or pillars in a building or construction work. This building material is made from a mixture of cement, sand and water[1][13][14].There are different qualities of concrete brick, depending on how it is made. For example, quality A and B bricks are made with automatic media machines, while quality C and D bricks are made manually by one operator as the printer [2][15].

The factory where C and D quality concrete bricks are made at one of the SMEs in the Tasikmalaya district has a very unique and attractive workplace design [2]. The design of many small businesses' workplaces is not conducive to proper ergonomics, often forcing workers to adopt awkward, unnatural positions that can lead to MSDs[3][16][17].

In previous studies, ergonomic desks have been successfully added to workplaces in order to improve production productivity [2]. The addition of the ergonomics table may not necessarily reduce the risk of musculoskeletal disorders (MSDs), according to the RULA Score. The goal of this research is to compare the RULA score of workers before and after they have completed a repair. This will help to identify whether or not the repair has improved the worker's condition. The RULA method will be used to assess the ergonomic risk level, and the CATIA software will be used to measure the RULA risk level [18][19].

RULA measurements have been carried out using CATIA media to analyze workplace changes by adding a manual pressing machine [4]. The RULA method was used to measure the improvements made to the meta plant [3], The art of batik stamping is an ancient Thai tradition that uses intricate designs to create colorful fabric artwork [5]. With the help of robots, humans can collaborate more effectively [6], The machine assembly process is very detailed and precise. Every step is crucial in ensuring that the final product is of the highest quality [7]. A manufacturing factory is typically a large, industrial building where raw materials are transformed into finished products. The factory may be divided into different sections for different stages of production, and there is usually a lot of heavy machinery involved. The noise and activity level in a factory can be quite overwhelming [8], material handling [9], The manufacture of pumps is an important industry [10], The aircraft manufacturing industry manufactures aircraft [11], The iron industry refers to the industrial sector that produces iron and steel, among other products [12]. Given the lack of research on the RULA Score with an ergonomics table, this study provides novel insights into how to address the problems identified in previous studies [20][21][22][23].

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Method

The research method used in this study is a comparative method. This method involves comparing the conditions before and after a development is carried out.

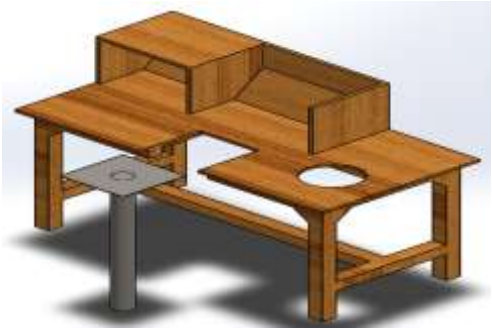

Figure 1. Applied Ergonomics Table

The development process includes adding an ergonomics table, as illustrated in Figure 1. It is important to note that before the development, the workplace design was not conducive to operators working in a squatting position. However, after the development, the operator's work position was standing. The therblig method will be used to analyze both conditions.

Figure 2. Demonstrates The Measurements Taken Before Any Development Occurred.

The Therblig method is a systematic way of breaking down a main movement into its component parts. This can help to identify inefficiencies and optimize the overall process. The ergonomic risk level of each work position will be analyzed using the Rapid Upper Limb Assessment (RULA) method, with the help of CATIA software. This will allow us to identify which elements of movement are more risky and need to be addressed. The doctor will measure various parts of your upper body, including your arm, forearm, wrist, and neck. They will also assess your posture and muscle strength. Finally, they will measure the force load on your legs [4].

Figure 3. Measurement Before Development

The parts that the RULA measuring system found to be at high ergonomic risk will have a value that reflects the level of risk. These values are described as follows :

- A score of 1-2 indicates that the paper is acceptable, but may need to be revised for length and consistency. A score of 2 indicates that the paper is of high quality and should be accepted without revision.
- Further examination and changes are needed for a score of 3-4.
- Score 3-4 indicates that further examination and changes are needed.
- There are a few areas that need improvement. Some changes need to be made right away in order to improve the quality of the work.
- There are a few areas that need improvement. Some changes need to be made right away in order to improve the quality of the work.
- Score is currently at 7 and there are many changes that need to be made soon.

The position of each movement element is converted into a virtual image using CATIA software in order to carry out the measurement process, as shown in Figures 3 and 2. After the virtual image is formed, the RULA Score measurement process is carried out and the results of the analysis will show the total score and detailing score. This will allow for a more accurate assessment of the overall posture and ergonomic risk.

There are two main types of data that can be collected: qualitative data and quantitative data. The qualitative data provides a description of each work element, while the quantitative data is in the form of the RULA Score of each movement element. The data is processed and analyzed using a comparison formula. The overall research methodology is shown in Figure 4.

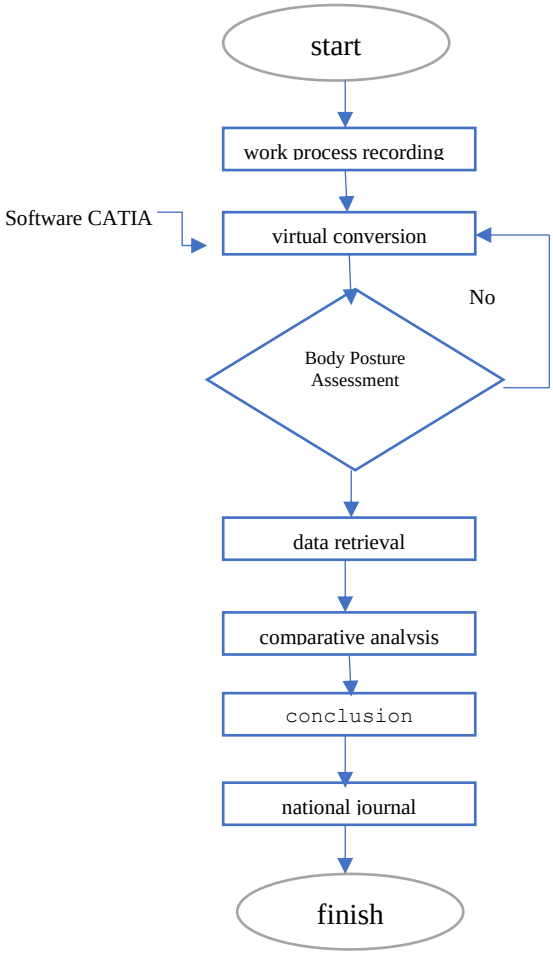

Figure 4. Research Flowchart

Results And Discussion

The table shows the before and after results of the development of the movement broken down into 19 elements. These elements include cleaning the inside mold, returning the cloth, and storing the paving block results.

The average RULA score before development was 6.9. The average value is between a score of 5-7, which means that inspections and changes need to be made immediately [4][24].

The workplace design needs to be changed immediately, and development has been done by adding tables. The ergonomics of the workstation were assessed using the RULA method. After development, the average RULA score is 3.9. This score indicates that the for potential ergonomic risks is low. The average value is between a score of 3-4, which means that the situation needs to be looked at more closely and changes need to be made [4]. The development succeeded in reducing the RULA Score by 3 points, from 6.9 to 3.9. This indicates that the level of ergonomic risk was reduced by 43%.

Table 1. Movement Elements and RULA Scores Before and After Development

Movement Elements Before Development	*Rula Score*	*Rula Score*	Movement Elements After Development	
Cleaning the Inner Mold	7	4	Cleaning the Inner Mold	
Restore Lap	7	4	Restore Lap	
Take Fine Cement	6	3	Take Fine Cement	
Putting in the Big Print	7	4	Putting in the Big Print	
Tidying Fine Cement	7	4	Tidying Fine Cement	
Approach Coarse Cement	7	4	Approach Coarse Cement	
Taking Coarse Cement	7	4	Taking Coarse Cement	
Putting Into Big Print	7	4	Putting Into Big Print	
Levelling the Temporary Surface	7	4	Leveling the Temporary Surface	
Take the Beater	7	4	Take the Beater	
Hit the mold	7	4	Hit the mold	
Re-level the surface	7	4	Re-level the surface	
Take a stand	7	4	Take a stand	
Assemble stand Into Large Mold	6	3	Assemble stand Into Large Mold	
Reverse the Big Print	7	4	Reverse the Big Print	
Cleaning around the Large Print	7	4	Cleaning around the Large Print	
Lifting Large Prints	7	4	Lifting Large Prints	
Taking Deep Prints	7	4	Taking Deep Prints	
Saving Paving Block Results	7	4	Saving Paving Block Results	
Average Value	6,9	3,9	Decrease :	43%

Conclusion

The average RULA score before development is 6.9, which indicates that development must be carried out immediately. The average RULA score after development is 3.9, which indicates that only small changes are needed. Even though the final development result still requires minor changes, the development reduced the score by 3 points from 6.9 to 3.9 thereby reducing the level of ergonomics risk by 43%.

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