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RULA Analysis of Work-Related Disorders Of Foundry Industry Worker Using Digital Human Modeling (DHM)

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Abstract: Ergonomic troubles are major issues faced by the metalwork manufacture. The ergonomics principles play very life-sustaining role in operators' productivity. The two factors such as workstation layout and work design are important for operators' or workers' efficiency. Work-Related Musculoskeletal disorder (WMSD) is the common health problems of the industrial workers. This health problem can lead to long term effect on the output performance. The objective of this work is to study the postures of industrial worker in foundry industry using the RULA assessment using CATIA V5R19 software. The working postures were modelled in the CATIA V5 R19 software and then RULA assessment was conducted. From the RULA analysis, several awkward postures were detected with high in risk ingredients. This paper presents an ergonomic evaluation of workstation in a one foundry industry at sangali in Maharashtra state. The Various key postures of the workers were evaluated . Also study includes suggestions for the improvement. Tools like Rapid Upper Limb Assessment (RULA) and digital human manikin (DHM) were used in this study.

Keywords: *Ergonomics, RULA Analysis, WMSD, Posture, CATIA, DHM.*

1. Introduction

Industrial workers are easier to be exposed to discomfort and pain at work. The occupational risk factors are the biggest factors to these health problems and it can be found in any industries (Halim, et al. 2005). MSDs are able to degrade the health of the workers thus reduces the workers' performance in completing their tasks. Several literatures had suggested that the effect of low performance by the workers can have significant economic and social consequences [4, 5, 6, 7]. This can be seen by the compensation claims for the employers that are increasing which may overburden the health system [8, 9]. One of the major reasons for sick leave and work injuries in the industry is due to the inefficient of production ergonomics. Moreover, manufacturing companies had lost a huge amount of money in their resource budget to support the staff replacement and rehabilitation. Reports from many researchers had stated that production interruption and companies' inefficiency may be caused by the high staff turnover and sick leave [11, 12, 13]. Because of this downside, it is important to ensure the health of the workers and their postures is one of the factors that need to be considered closely in running certain work task. A basic analysis of a work task can depend on questionnaires, interviews and video analysis. In addition, numerous measurements commonly known as assessment method can be used for physical risk assessment of job activities, usually specific to a body part or a type of activity. There are various ergonomic assessment method of manual tasks exist in the market. For example, are the RULA, REBA, OWAS, LUBA, QEC, PATH and PEO method [14, 15, 3]. Rapid Upper Limb Assessment (RULA) index is one of the most cited and commonly used tools for evaluating ergonomic risk of work-related MSDs [15, 16]. RULA is a subjective observation method for posture analysis that focuses on the upper part of the body with the particular attention to the neck, trunk and upper limbs [17, 18, 15]. Observational methods based on videotaped work task sequences to analyze various kinds of manual tasks with certain software are widely used nowadays because of its practicality and affordability [19, 15]. When designing a new task, another option is to use digital human models.

2. Methodology

This study was conducted at one of the foundry industry in Astha Liners Sangli area. The chosen subject is from the fetlling department.

A simple subjective rating form was given to the subject to be completed in order to evaluate the posture discomfort experienced. Next, the subject was required to conduct his working cycle as usual and the process was recorded through a video recorder.

The postures of the working cycle were recorded from the Mid-Sagittal plane view.

Several postures from the subject working cycle then are chosen and replicate into a manikin in the CATIA V5R19 software. Later, the RULA analysis was performed on the manikin with exact replication to assess the subject's posture level of discomfort.

3. Result and Discussion

From the subject working cycle were recorded. The results of RULA analysis are shown in Table 1 for every postures involved.

This analysis also shows the body segments that are having problems.

Fig-01: Postures attained by an operator with actual working (a) Posture 1 (b) Posture 2 (c) Posture 3 (d) Posture 4.

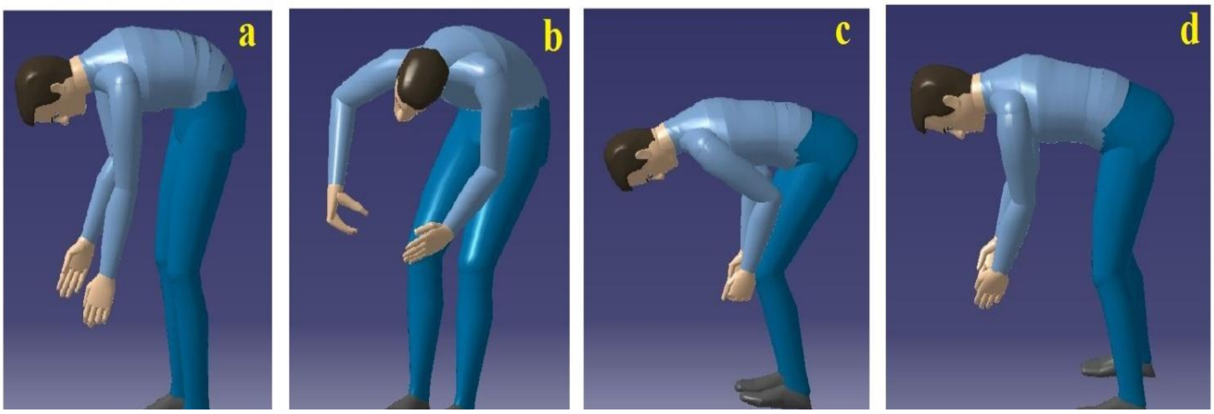

Fig-02: Modelled postures attained by an operator (a) Posture 1 (b) Posture 2 (c) Posture 3 (d) Posture 4.

Fig-03: RULA score of an Modelled postures operator (a) Posture 1 (b) Posture 2 (c) Posture 3 (d) Posture 4.

Fig. 1 shows four postures attained by the operator at actual working at fettling department for finishing the disc using grinder.

Fig. 2 show the corresponding postures modeled using DHM technique. At most care was taken to model the posture as operator attains during work.

From fig. 3 and RULA analysis, posture 'a' show that the posture Score is 6 and orange in color. This means that investigates further and Change soon. The problematic parts are detected around the muscle, Neck, trunk and Leg.

Posture 'b' is the working condition where the subject is finishing the disc product. The subject required to bend more to complete the task. RULA analysis of posture 'b' shows that the posture level is 7 and red in color. This means that investigation and changes are required immediately. The problematic parts are detected around the forearm, upper arm, and wrist.

Posture 'c' is when the subject is finishing the disc product. RULA analysis of posture 3 shows the posture score is 4 and yellow in color. This indicates that further investigation is needed and changes may be required. Result score shows that posture is in good condition and further investigation is needed for any changes.

During posture 'd', From RULA analysis, it can be seen that the posture score is 5 and orange in color. This indicates that Investigation and changes are needed soon.

3.1. Overall Analysis

The RULA analysis results from all four postures involved are summarized and shown in Table 1.

Table-1: RULA analysis result for every posture

Posture	Score	Color	Statement
1	06		Investigate further and Change soon
2	07		Investigate and Change Immediately
3	04		Investigate Further
4	05		Investigate further and Change soon

Table-2: Interpretation of RULA score in basic mode

Sr. No.	Score	Color	Meaning
1	1 and 2	Green	The posture is acceptable if it is not retained or repeated for longer period
2	3 and 4	Yellow	Further investigation is required and changes may also be required.
3	5 and 6	Orange	Investigation and changes are needed soon.
4	7	Red	Investigation and changes are needed immediately.

From the finding of postural analysis using the RULA method shows that posture 'a' , posture 'b' and posture 'd' are hazardous; therefore, these postures need to be investigated and change immediately. Meanwhile, the other posture that is posture 'c' are still acceptable but need to be investigated further whether the working posture are needed to be changed or in the near future.

After the changes the done in the future, the production rate where the subject is working is expected to increase as shown from the studies done by (Vink et al. 2006) which stated that if improvement is done on the workstation for ergonomic reason the production rate will be increased. But, the value of the productivity cannot be known its exact
value because of limited information from the company.

Several recommendations that the company can apply in the future in order to ensure worker comfort are to use the manipulator arm even for handling a lower load the product. Repetitive works can affect the workers' health even though the load is small. The workstation renovation also can ensure a good and comfortable working environment for example by constructing a platform in fettling department.

Besides that, a construction of a platform some heights can lower the distance, height of the subject to put up the product on the platform.
Figure 4 shows this improvement platform can reduce the discomfort problems for the subject.

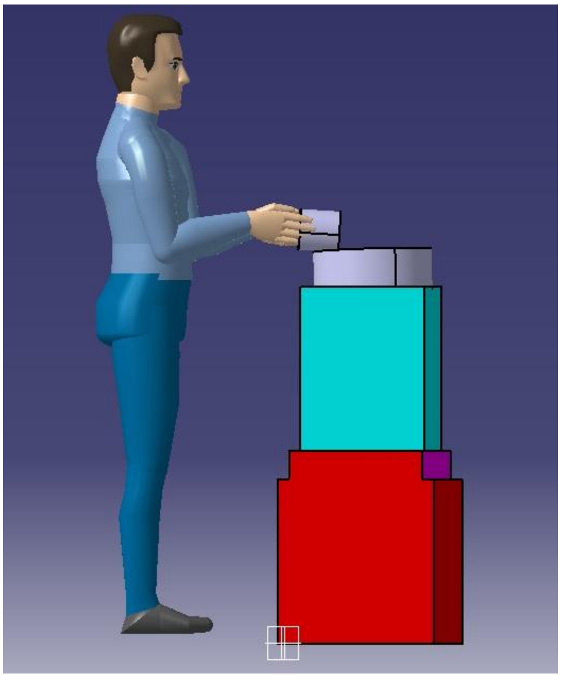

Fig-4: Improvement platform

However, there are certain limitations in this study using the RULA analysis because it only assessed the upper part of the body postures. For obtaining analysis result that is more drought and extensive, several postural analysis methods for whole body assessment is suggested, such as the Rapid Entire Body Assessment (REBA), Ovako working posture assessment system (OWAS), Workplace ergonomics risk assessment (WERA), and posture, activity, tools and handling (PATH) method. But the reason RULA assessment is chosen as the postural analysis method in this study is due to the working cycle of the selected subjects mainly involved the movement of the upper extremities.

4. Conclusion

It can be concluded that awkward postures could be detected using RULA assessment in CATIA V5 R19. Analysis shows that further improvement is needed on the manual fettling workstation to avoid discomfort and further disorders. The ergonomically designed industrial work station, machines/equipments can reduce drudgery, increase efficiency, safety and comfort.

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