Rapid Entire Body and Rapid Upper Limb Assessment of Operator for Multipurpose Wheel Lathe Machine

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ABSTRACT
This paper presents a study, where ergonomic evaluations were conducted in work stations related with the operation of machining on Multipurpose Wheel Lathe Machine (MFD Hegenscheidt). A wheel lathe is a machine tool used in the manufacturing and reconditioning of wheels. The objective of the study was to assess postures of operator, working on multipurpose wheel lathe by using Rapid Upper Limb Assessment (RULA) & Rapid Entire Body Assessment (REBA) for ergonomic Evaluation. The study was conducted on a worker engaged in Carriage Workshop Kurudvadi (Maharashtra, India). Video tape on activities of the workers was prepared and then images were cropped from it for the analysis. The model and manikin was prepared for analysis. The scope of this study is to investigate the awkward postures of operator working on multipurpose wheel lathe machine for identifying any particular change required to be implemented in the workstation related to the multipurpose wheel lathe machine.

Keywords - Ergonomics, RULA, REBA.

1. INTRODUCTION
The ergonomics is an independent subject developed from the beginning of the 20th century, and it is the frontier applied science which studies the comprehensive performances such as comfort ability, production efficiency and safety under various conditions. The common occupational problem of the workers is musculoskeletal disorders in India. This paper presents a study, where ergonomic evaluations were conducted in work stations related with the operation of machining on Multipurpose Wheel Lathe Machine (MFD Hegenscheidt). The objective of the study was to assess postures of operator, working on multipurpose wheel lathe by using Rapid Upper Limb Assessment (RULA) & Rapid Entire Body Assessment (REBA) for ergonomic Evaluation. The study was conducted on a worker engaged in Carriage Workshop Kurudvadi (Maharashtra, India). Video tape on activities of the workers was prepared and then images were cropped from it for the analysis. The scope of this study is to investigate the awkward postures of operator working on multipurpose wheel lathe machine for identifying any particular change required to be implemented in the workstation related to the multipurpose wheel lathe machine.

2. LITERATURE SURVEY
Ergonomic Evaluation of Work Stations Related With the Operation of Advanced Manufacturing Technology Equipment: Two cases of study [2009] [Aide Maldonado- Macias, Maria Guadalupe Ramírez, Jorge Luis García, Juan José Díaz1, and
Salvador Noriega] This paper presents two cases of study where ergonomic evaluations were conducted in work stations related with the operation of Advanced Manufacturing Technology (AMT) equipment: Computer Numerical Control (CNC) Milling Machine and (CNC) Lathe. The Marley and Kumar (1996) Body Map format among 10 workers was conducted for pain in discomfort study and Hignett and McAtamney (2000) REBA method was used for ergonomic evaluation. Shoulders, middle back, hand and arm pain was identified. The evaluation results indicated a medium risk level for both work stations according to REBA. Recommendations for changes in equipment components and the work station are presented and it is found that models that would help identify and evaluate ergonomic aspects related with AMT equipment are desirable among decision makers, owners and users.

Evaluation of work Posture by RULA and REBA: A Case Study [2014] [N. A. Ansari, Dr. M. J. Sheikh] The common occupational problem of the workers is musculoskeletal disorders in India. Currently the work is being carried out manually in most of the small scale industries therefore the issues of work related musculoskeletal disorders and injury in different body sites are of top priority. Postural analysis tool using Rapid upper limb assessment (RULA) and Rapid entire body assessment (REBA) were applied for assessment which indicates that the workers are working above the secure limit. This ergonomic study sheds light on posture analysis of the workers in small scale industry. The study was conducted on 15 workers engaged in small scale industry situated at MIDC Wardha (Maharashtra, India). Video tape on different activities of the workers was prepared and then images were cropped from it for the analysis. This study presents assessment of work posture of workers engaged in different activities of small scale industry. Evaluation of posture was carried out using RULA and REBA. Assessment is carried out using worksheet. The RULA method determined that the majority of the workers were under high risk levels and required immediate change. The REBA method determined that some of the workers were under lower levels and majority at high risk levels. Hence it was concluded that; there is a lack of ergonomics awareness and understanding in small scale industries. Evaluation using postural analysis by RULA and REBA indicates that the workers are working above the secure limit. The major percentage of the workers having awkward postures. Thus the workers are under moderate to high risk of musculoskeletal disorders.

Ergonomics Evaluation of Body Posture of Worker In SSI [2014] [Prof. R. D. Vaidya, Prof. K.G. Sontakke, Prof. N. A. Ansari] The working at shop floor is multifunctional and complex tasks with a great responsibility. Working for the long period of time causes higher risk of musculoskeletal disorders. The workers suffer from the high risk and gives poor performance because of inappropriate match between anthropometry and work station. Musculoskeletal disorders (MSDs) are surrounded by the most common work-related problem in India. In an Indian manufacturing industry most of the work is still carried out manually hence issues of work related musculoskeletal disorders and injury in different sites of the body are prominent.

Postural analysis using Rapid entire body assessment (REBA), Rapid upper limb assessment (RULA) indicates that the workers are working above the secure limit. The presents study is focused on posture analysis of the workers working in small scale manufacturing industry. The study was conducted on 15 workers engaged in small scale manufacturing industry Wardha (Maharashtra, India). Video tape on different activities of the workers was done and then images were cropped from it for the analysis. It was concluded that; there is a lack of ergonomics social contact and understanding in small scale manufacturing industries (SSMIs). Postural analysis using REBA, RULA indicates that the workers are working above the secure limit. A major quantity of the workers is
working in awkward postures. Thus the workers are under moderate to high risk of Musculoskeletal disorders (MSDs).

Study and Justification of Body Postures of Workers Working In SSI by Using Reba [2014] [N. A. Ansari, P. N. Shende, M. J. Sheikh, R. D. Vaidya] An efficient and effective system, which is the base of a productive system, depends on the manner of service delivery by human operators. Important aspect is ergonomics in order to improve performance of workers at work, develop an independent measure at work which will coordinate psychological, physical, and physiological aspects that is dependable for person behavior and effectiveness at work and stand as a key factor deciding workers efficiency. This paper center of attention on the ergonomics thought required to be governed in the small scale industries (SSIs), a precise case of Cultivators and Harvester manufacturing unit is considered, which is different from all these aspects. mainly, an important & large component „turn table” is consider for analyzing the ergonomic manufacturing methods. The crack between ergonomic considerations and actual practices at the place of work gives the standpoint to design the workstation. The data of musculoskeletal disorder of employee working at workplace of Cultivators and Harvester manufacturing unit is collected, analyzed and justified by using REBA.

3. METHOD OF ANALYSIS
This research study is conducted at Carriage workshop situated at Kurudvadi, Maharashtra, India. An operator of multipurpose wheel lathe machine was for study, of stature 1585 mm, age 51 years, weight 66 kilograms and average experience 8 years. The video recording of their postures showing movements of the workers during working was recorded. After footage the video, it was cropped to get snapshots for the analysis of posture of the worker. Snapshots of worker performing his work were obtained. The snapshots were analyzed to fill the scores in RULA and REBA worksheet developed by Dr. Alan Hedge. The model and manikin was prepared for analysis and the results were also compared with RULA results.

3.1 Ergonomic Evaluation of Postures of Operator for Multipurpose Lathe Machine by Using RULA and REBA.
Rapid Upper Limb Assessment: Using the RULA worksheet, the score is assigned for each of the following body regions: upper arm, lower arm, wrist, neck, trunk, and legs. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk as outlined below:

<table>
<thead>
<tr>
<th>Score</th>
<th>MSD risk level</th>
<th>Action required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Ignorable risk</td>
<td>No action required</td>
</tr>
<tr>
<td>3-4</td>
<td>Low risk</td>
<td>Change may be needed</td>
</tr>
<tr>
<td>5-6</td>
<td>Medium risk</td>
<td>Further investigation, change soon</td>
</tr>
<tr>
<td>6+</td>
<td>Very high risk</td>
<td>Immediate change to be implemented</td>
</tr>
</tbody>
</table>

Rapid Entire Body Assessment: This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. A single page worksheet is used to evaluate required or selected body posture, forceful exertions, type of movement or action, repetition, and coupling. Using the REBA worksheet, the score is assigned for each of the following body regions: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk:

<table>
<thead>
<tr>
<th>Score</th>
<th>MSD risk level</th>
<th>Action required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ignorable risk</td>
<td>No action required</td>
</tr>
<tr>
<td>2-3</td>
<td>Low risk</td>
<td>Change may be needed</td>
</tr>
<tr>
<td>4-7</td>
<td>Medium risk</td>
<td>Further investigation, change soon</td>
</tr>
<tr>
<td>8-10</td>
<td>High risk</td>
<td>Investigate and implement change</td>
</tr>
<tr>
<td>11+</td>
<td>Very high risk</td>
<td>Immediate change to be implemented</td>
</tr>
</tbody>
</table>
3.2 Description of operation and work station
Pictures of operators postures while working on multipurpose wheel lathe machine [William Hegenscheidt Mfd 1960]

**Posture 1**

**Posture 2**

**Posture 3**

**Posture 4**

Figure 1. Postures Adopted During Working

Description of posture adopted during working:
Posture.1- In the above screenshot the operator is standing on the machine with both arm stretched in the awkward posture due to the improper height of the wooden platform and the difficulty in viewing the tool while in operation.
Posture.2-lack of proper grip on the forward feed handle and lateral feed handle. The operator sometimes holds the forward feed handle in the middle of arm due to large length of the forward feed handle, which”s undesirably increasing the working space of left arm.
Posture.3-For measuring diameter of the wheel the operator has to climb over the machine while one leg on chuck and other on the lathe bed which is inconvenient.
Posture.4-When the operator is free of all physical work exclusive of inspecting the turning operation, can’t stand in proper standing posture as it can be seen the right side screenshot.

4. RESULTS
At present the grand score of RULA & REBA is 7 & 14, which is also compared with the results of RULA analysis in CATIA. As the RULA grand score is 7 there’s a need of investigating and implementing change in Multipurpose Wheel Lathe Machine with some modification. While the REBA grand score is 14 i.e., 11+ which implies Very High risk level which means the workstation has to be changed.

5. CONCLUSION
In the machining process where workers are working in standing posture lack of knowledge regarding ergonomics is studied and analyzed in industry in which work is carried out.
Musculoskeletal disorders are found and it shows that there is need to modify the Multipurpose Wheel Lathe machine and existing body posture of the operator. Mostly in the upper body section the extremity of pain is more and cause of rigorous trouble to worker in the outlook which they do not understand and sense now. It is justified through RULA and REBA which gives score of 7 & 14 i.e., 11+, which lies in Very High Risk Level.
APPENDIX


2. Rapid Upper Limb Assessment Worksheet.


3. RULA analysis through CATIA

REFERENCES


