International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Implementation of Rapid Upper Limb Assessment Technique in Automotive Parts Manufacturing Industry

D.Arunkumar, V.Ramesh, Skanda M G

Abstract: ***Workplace safety is a paramount aspect of for any industry. It is the responsibility of the employer to provide a safe and hazard free environment by minimizing the risk. Current study focuses on the implementation of Rapid Upper Limb assessment (RULA) in an automotive parts manufacturing industry. Based on the research conducted it is argued that, there is a scope in the manufacturing industries to conduct ergonomic study to create a safe working environment with minimum risk and effort. The industry has successfully implemented all the suggestions made by the authors without much investment. This case study is an attempt to create an awareness and healthy workplace environment by ergonomic interventions. RULA method found to be useful assessment technique and acts as a proactive tool to handle safety issues in the work place.***

Keywords: ***Workplace safety, Musculoskeletal Disorders, Workplace Assessment, Rapid Upper Limb Assessment.***

I. INTRODUCTION

The study of ergonomics and human machine interaction plays an important role in safety critical domains. In order to prevent incidents and accidents in any safety critical industries anthropometric considerations of human-system fit i.e. such as the size and shape of tools with the body measurements should be given paramount importance. It is the duty of the employer to ensure safe working practices without the risk of causing injury by providing a safe and conducive work environment. A Workplace Assessment technique like Rapid Upper Limb Assessment is a proactive approach to assess the perceptions of /the employees and managers in an organization towards their work environment. RULA provides the details to all the stakeholders of the organizations about the real time problems and enables the stakeholders to take action to resolve them. Workplace assessments not only assesses the negative aspects of the organization it also indicates the positive aspects of the organization. This results the management of the organization to leverage the strengths and helps in promoting the desired behaviors and best work practices.

Manuscript published on 30 September 2019
* Correspondence Author
Dr. D.Arun Kumar* , Associate Professor, Department of Industrial and Production Engineering, JSS Science and Technology University, Mysore, Karnataka, India
Dr. V.RAMESH , Professor, Department of Industrial and Production Engineering, JSS Science and Technology University, Mysore, Karnataka, India
Prof. Skanda M.G Assistant Professor, Department of Industrial and Production Engineering, JSS Science and Technology University, Mysore, Karnataka, India

II. LITERATURE REVIEW

Current section focuses on the review of the prominent research articles related to ergonomic interventions and workplace assessments methods.

Equalities Act states that, “the employer has a responsibility to make the workplace safe for their employees. It is the duty of the employer to ensure safe working practices without the risk of causing injury by providing a safe and conducive work environment” [1].

Literature reveals that, many administrative and engineering control measures are necessary to prevent certain occupational ailments such as chronic venous insufficiency, preterm birth and spontaneous abortion, and carotid atherosclerosis are caused due to the prolonged standing while carrying out tasks [2].

The ultimate objective of any ergonomist or human factors expert is to increase the performance and productivity of the worker using proper ergonomic interventions. Implementation of proper ergonomics in workplaces would help the human operator to feel comfortable and secure [3]. In order to meet the deadline and competition operators work under harsh working environments. Working environment which is not conducive to safety eventually give rise to various musculoskeletal disorders (MSD). MSD risks emerge over the years due to repetitive lifting, differential lifting height [4]. Specific to manufacturing units, Parimalam P. et al. [5] in their research on ergonomic analysis of garment manufacturing unit found out that, there had been numerous gaps in workplace environment, tools and equipment that affect the health and safety of workers at the work site. M. C.I. Javier Antonio Lom Holguín et al. [6], opined ergonomics related to the design of methods and processes can help remove or decrease the work related risks and it helps in improving organization’s quality and productivity. Aman Sachdeva. et al [7] specifically studied the MSD patterns in lathe workers, in their study it is observed repetitive lifting and repetitive lifting with differential heights tends to cause MSD in workers body. L. P. Singh [8]

conducted a study in forging units to assess the RULA (Rapid Upper Limb Assessment), REBA (Rapid Entire Body Assessment) and OWAS (Ovaku Work posture Analysis) study concluded that, many of the workers carried their work in bad posture especially in grinding section thus the workers were under risk of MSDs.

Based on the preliminary literature survey it was found that, not many studies have been conducted specific to medium and small scale manufacturing organizations. Current study focuses on the implementation of RULA in some of the units of an automotive parts manufacturing industry. It was observed that, preliminary interview with the company personnel revealed that there is a lack of ergonomics planning and application of intervention techniques, this leads to proportion of the workers carrying their task in bad postures. Current study is an attempt to implement and create awareness among the workers about the ergonomics interventions and evaluation using RULA technique.

2.1 RAPID UPPER LIMB ASSESSMENT (RULA)

Lynn McAtamney and E Nigel Corlett [3] developed RULA to provide a rapid objective measure musculoskeletal risk caused predominantly by sedentary life tasks. It is validated by the European community directive and Institution of Occupational Ergonomics.RULA evaluates the posture, strength and movement associated with sedentary activities. RULA does not require any special equipment to provide a quick evaluation of positions of the neck, trunk and upper limbs with muscular function and external loads experienced by the body. The application of RULA extends to entire body and it uses postural scoring method. Specifically, RULA focuses on assessment of upper limbs, neck and trunk region of the body and it helps in measuring musculoskeletal risks involved in workplace.

III. RULA METHODOLOGY

The case study was conducted in Rane (Madras) Steering and Suspension parts manufacturing plant in Mysore City. The following flow diagram represents standard operating procedure for RULA assessment.

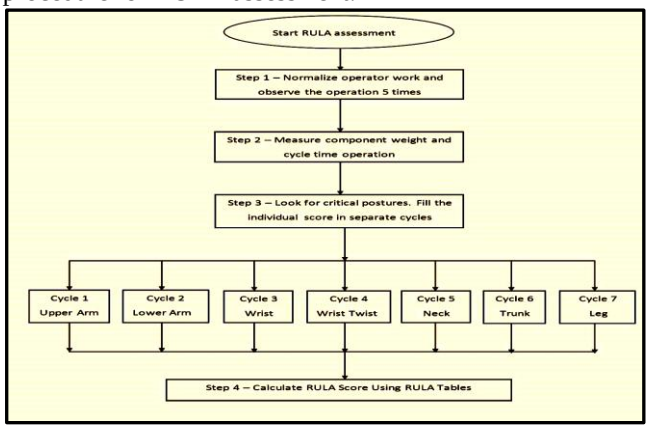


Figure.1: Standard Operating Procedure (SOP) for RULA Assessment

The manufacturing plant has categorized the ergonomics assessment into three categories namely Alert zone, Acceptable zone and Comfortable zone. The three zone classification is based on the favorable and unfavorable working conditions which causes stress to the operator. As the name indicates alert zone is one which is unfavorable to the operators causing stress and strain. Zone in which working conditions are favorable but still there is scope for improvement is termed as acceptable zone and in comfortable zone workers operate comfortably without stress and strain.

IV. ASSESSMENT AND ANALYSIS

The ergonomic assessment and RULA is applied to for number of work stations including Rocker shaft line, Box line, Worm and Nut line and Assembly line. Authors conducted an ergonomics study in Rocker shaft line and inferred that there is no alert zone. Thus, the rocker shaft line is in acceptable zone as their final RULA score is between 5 and 6 In Box line the authors inferred that all operations are in Acceptable zone except Base milling and Dowel drilling which is in Alert zone as their final RULA score has exceeded 7. In Worm and Nut line the authors observed that all operations are in Acceptable zone as their final RULA score is between 5 and 6. In SGP line most of the operations are in the Alert zone as the RULA score is 7. In SSLP line all operations are in Acceptable zone as the RULA score is between 5 and 6. The results of these work stations are analyzed and the Maximum alert zone area is found in the Box line. Thus, this study focuses on the ergonomics in Box line.

Module Cell: Box Line

Sl. No.	Operation	RULA score			Work sheet score	Final RULA score	Zone disposition
		Arm score	Neck, trunk, and leg score	Overall score			
1	Box machining	4	2	3	2.3	5	Acceptable zone
2	Radial drilling	5	2	4	3	5	Acceptable zone
3	Column and cover face milling	5	2	4	2.7	5	Acceptable zone
4	Base milling	5	4	5	3.2	8	Alert zone
5	Bush pressing	5	2	4	3	5	Acceptable zone
6	Two way boring	4	2	3	3	6	Acceptable zone
7	Bush burnishing	5	2	3	3	5	Acceptable zone
8	Dowel drilling	5	4	4	3.2	7	Alert zone
9	Dowel reaming	5	2	4	3	5	Acceptable zone
10	Mounting holes drilling	5	2	4	3.1	6	Acceptable zone

V. DISCUSSION

It was observed from the study that the operator used to clamp the component manually. He suggested to the management to replace manual clamping with power/hydraulic clamping in order to reduce risk of injury, effort and facilitate easy operation. With the implementation of Power clamping, the authors inferred that there is an improvement in the working condition as there is less risk and effort involved in performing the operations. The improvement in the posture of the operator is seen when compared to poor posture in manual clamping. The authors arrived at the Ergonomic score by combining the RULA assessment score and Work place audit score.

TABLE 1. RULA SCORE

Work Place Score	RULA Score						
	1	2	3	4	5	6	7
0.1-1.0	1	2	3	4	5	6	7
1.1-2.0	2	3	4	5	6	7	8
2.1-3.0	3	4	5	6	7	8	9
3.1-4.0	4	5	6	7	8	9	10
4.1-5.0	5	6	7	8	9	10	11

Table 2. RULA SCORE

Work Place Score	RULA Score						
	1	2	3	4	5	6	7
0.1-1.0	1	2	3	4	5	6	7
1.1-2.0	2	3	4	5	6	7	8
2.1-3.0	3	4	5	6	7	8	9
3.1-4.0	4	5	6	7	8	9	10
4.1-5.0	5	6	7	8	9	10	11

Before implementation of the power clamping, the final Ergonomic RULA score is 8. i.e. the base milling operation is in the Alert Zone.

After the implementation of power clamping, the final Ergonomic score is 5. i.e. the base milling is in Acceptable Zone

VI. CONCLUSION

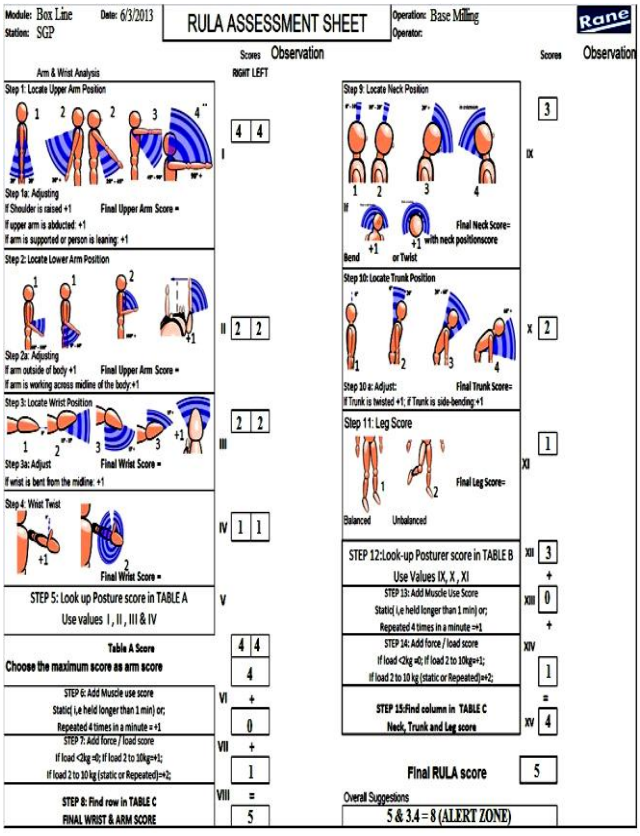
The research study is conducted Rocker shaft line, Box assembly line, worm and nut line, SSLP line, SGP line in various work stations of the automotive part manufacturing industry revealed that the working conditions are not favorable and it is conducive for employees in some of the work stations like Box assembly line, SGP line. In these work stations the employees are working in Alert zone with high risk of injury, more effort, and more stress and strain affecting their physical and mental health. Hence it was suggested to the Management of the industry to implement the composite scoring system of RULA and work place assessment methods in order to reduce the ergonomic hazards, so that the employees operate safely in comfortable zone or at least in acceptable zone.

In Base milling operation, it was suggested to the Management to replace manual clamping with hydraulic clamping. With the implementation of the suggestion made by the authors, the posture of the operator is improved and the ergonomic hazard is shifted from alert zone to acceptable zone.

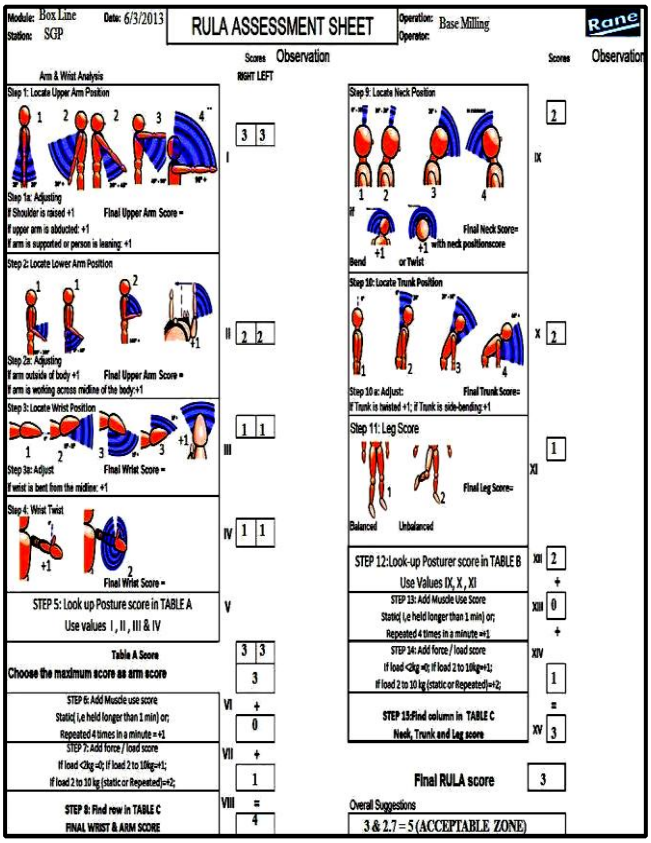
In column pressing operation, it was suggested to the Management to replace manual pressing with hydraulic pressing. With the implementation of the suggestion made by the authors the stress on the thumb while performing the operation is appreciably reduced and the ergonomic hazard is shifted from alert zone to acceptable zone.

The company has successfully implemented all the suggestions made by the authors without much investment. After the implementation, out of 240 work stations only 10 stations are in Alert zone, 225 stations are in acceptable zone and the remaining 5 stations are in comfortable zone. The authors is of the opinion that still the company has scope to improve the conditions in the work place to reduce the ergonomic hazards so that the employees always work in comfortable zone.

VII. APPENDIX



Before Assessment



After Implementation

REFERENCES

1. Health and Safety at Work Act, 1974, retrieved from http://www.hse.gov.uk/legislation/hswa.htm
2. Isa Halim& Abdul Rahman Omar, " A Review on Health Effects Associated with Prolonged Standing in The Industrial Workplaces," International Journal Of Research And Review In Applied Science, vol. 8, issue 1, July 2011
3. Lynn McAtamney and E Nigel Corlett, "RULA: a survey method for the investigation of world-related upper limb disorders", Butterworth-Heinemann Ltd", Applied Ergonomics 24(2), 91-99, Vol 24 No 2 April 1993
4. D. N. Agrawal et al.," Study and Validation of Body Postures Of Workers Working In Small Scale Industry through RULA," International Journal of Engineering Science and Technology, Vol. 3 No.10 October 2011
5. Parimalam P. et al., "Ergonomic interventions to improve work environment in garment manufacturing units," Indian Journal of Occupational and Environmental Medicine, August 2006 -Volume 10 - Issue 2
6. M. C.I. Javier Antonio Lom Holguín et al., "Ergonomics and its relationship to the design of production processes," PonenciaConergo 2008
7. Aman Sachdeva et al., "Minimizing Musculoskeletal Disorders in Lathe Machine Workers," International Journal of Ergonomics, Volume 1 Issue 2 2011
8. L. P. Singh., "Work Posture Assessment in Forging Industry: An Exploratory Study in INDIA," International Journal of Advanced Engineering Technology, vol. 1 issue III Oct.-Dec. 2010

AUTHORS PROFILE

Dr. D.Arun Kumar is a Professor in JSS Science and Technology University, Mysore since 32 years. He has done his PhD in Lean Manufacturing from VTU Belgaum. He has published 4 research papers in International journals and presented three research papers in International conferences.

Dr. V.Ramesh is a Professor and is working since 35 years in JSS Science and Technology University, Mysore and has published 25 Journals in various bodies and is the reviewer for the International Journal of Advanced Manufacturing Technology (IJAMT)

.

Mr. Skanda M G is an Assistant Professor and is working since 9 years in JSS Science and Technology University, Mysore and has recently submitted the PhD thesis in the area of Human Factors Engineering. He has published 3 research papers in International journals and presented three research papers in International conferences