ISSN: 2349- 5197
Impact Factor (PIF): 2.138

INTERNATIONAL JOURNAL OF RESEARCH SCIENCE & MANAGEMENT

ERGONOMIC ASSESSMENT AND RISK REDUCTION OF AUTOMOBILE ASSEMBLY TASKS USING POSTURAL ASSESSMENT TOOLS

Srikanth P Chakravarthya[1], Subbaiah.K.M[2] Shekar. G.L[3]
[1*] PG, Scholar, Department of Industrial & Production Engineering, The National Institute of Engineering, Mysore-570008, India
[2,3]Professor, Department of Industrial and Production Engineering, The National Institute of Engineering, Mysore-570008, India
Correspondence Author*:* srik.chakra05@gmail.com

Keywords: Health hazards, MSD, RULA,REBA

Abstract
Automotive is one of the fast growing industries which involve the design, development and manufacturing of motor vehicles. However, it has its own impediment as the interaction between man and machinery pose several health hazards. Work related musculoskeletal disorders (MSDs), low back injuries and poor body postures are the most common problems occurring in the automobile industries. The aim of this study was to identify the risks of work related MSDs and eliminates the same. The Rapid Upper Limb Assessment (RULA) & Rapid Entire Body Assessment (REBA) methods were used to find out the scores of working postures for the existing process .Engineering control actions were implemented to those process with high risk. Processes were reassessed using the tools. Substantial risk reduction was achieved.

Introduction
Automotive assembly is one of the important industries in certain countries and due to the nature of the tasks, workers in this particular industry are exposed to various working postures that could give rise to MSD. Many studies have also found that poor working posture is a major cause of back pain, workplace stress, resulting in lost time, reduced productivity, poor employee health and low morale. Many studies conducted among workers in an automotive industry found that MSD was a major problem and needed to be controlled.

RULA (Rapid upper limb assessment)
Rapid Upper Limb Assessment (RULA) is used for ergonomic investigations of workplaces where work related injuries are reported. RULA is a simple diagnostic tool that allows surveying various tasks involving the upper limbs at workplace with focuses on use of arms, wrists, position of the head and the posture of the upper body. McAtamney and Corlett (1993) introduce RULA, or Rapid Upper Limb Assessment [1]. It is developed to observe the operators who suffered upper limb disorders due to the musculoskeletal loading. The RULA is used without need for advanced and expensive equipment that's why it is one of the most popular ergonomic investigation tools in industry. It proved a tool which is reliable for use by those whose job it is to undertake workplace investigations.

REBA (Rapid entire body assessment)
REBA is an ergonomic assessment tool uses an orderly process to evaluate whole body postural MSD and risk associated with Workplaces. Hignett and McAtamney (2000) introduce REBA and stated that it is used to investigate posture for risk of work related musculoskeletal disorders (WRMSDs) [2]. REBA is a better tool for whole body parts (wrist, upper arm, lower arm, neck, trunk and legs,) REBA is user friendly and useful for manual task risk assessment.

Literature survey
Musculoskeletal disorders (MSD) represent one of the leading causes of occupational injury and disability in the developed and industrially developing countries [1]. Automotive assembly is one of the important industries in certain countries and due to the nature of the tasks, workers in this particular industry are exposed to various working postures that could give rise to MSD[2]. Ghasemkhan et al (2006) reported that the prevalence of MSD was found to be high among automotive assembly line workers [3]. Hussain, T. (2004) conducted study among truck assembly workers and found that as high as 79% of the workers had MSD[4]. Lynn McAanncy and E. Nigel Corlett (1993) proposed a method called RULA [5]. RULA is designed to assess operators who may be exposed to musculoskeletal loading. Hignett and Lynn McAtanncy (2000) proposed a method REBA. The REBA is a postural analysis tool sensitive to musculoskeletal risks in a variety of tasks and assessment of working postures found in health care and other service industries [6].
Kee D. and KarwowskiW. (2007) made a comparison of three observation at all techniques for assessing postural loads in industry [7]. For this study OWAS, RULA and REBA are taken as observational techniques. T. Jones and S. Kumar (2007) compare ergonomic risk assessment in a repetitive high risk sawmill occupation Saw-filler. For this they use Rapid Entire Body Assessment (REBA).[8]. Tarwinder Singh et al.(2014) studied the impact of bad body postures on MSDs in electronics industries using RULA & REBA[9]. Himanshu Chaudhary et al.(2013) reported that the exposure of worker in cardboard industries to MSD

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is high by using RULA & REBA[10]. N. A. Ansari et al (2014) evaluated working postures in small scale industries using RULA & REBA and concluded that there is a moderate to high risk of MSD occurrence [11].
Vignais N et al. (2013) studied a system that permits a real-time ergonomic assessment of manual tasks in an industrial environment [12].A.R. Anita et al.(2014) carried out analysis of awkward posture among assembly line workers using the Rapid Upper Limb Assessment (RULA) technique [13].REBA is useful for manual tasks risk assessment. REBA proposes the prioritization for corrective measures according to risk assessment and risk level.[10] .A computerized RULA ergonomic assessment was implemented to permit a global risk assessment of musculoskeletal disorders in real-time. Changet al. (2007) proposed a method of conducting work place valuations in the digital environment for the prevention of work-related musculoskeletal disorders and apply a digital human modelling system to the workplace virtual dynamic simulation [14].
Abdullah et al. (2009) studied to identify and quantify ergonomics working postures that contributed to the serious development of musculo skeletal injuries and thus investigated possible contributory their related causes[15]. Asim Zaheer et al. Claims that the application of ergonomic principles would help to increase machine performance and productivity, but mostly help human operator to be comfortable and secure[16]

Methodology

Twenty different processes carried out in a particular team of an automobile major were analyzed to find out the causes of MSDs .It resulted due to adoption of poor postures adopted by worker during manual assembly tasks. Posture analysis techniques were used to find out the same.
All the tasks are carried out in each work cycle. The most difficult tasks and the task which was carried out for the highest duration of time were videotaped from different angles. Picture frames were taken from these videos. Each frame of a task was further analysed by using RULA and REBA techniques. The angles of each body postures were found out for each picture frame. Ergofellow 2.0 software was used for finding the body angles. The RULA& REBA score were found out using the same software. RULA & REBA scores that represents the level of MSD risk is listed below. Improvement activities were carried out only for those tasks with substantial risk level.

Table I: RULA score

Score	**Level of MSD Risk**
1-2	Negligible risk, no action required
3-4	Low risk, change may be needed
5-6	Medium risk, further investigation change soon
7+	Very high risk, implement change now

Table 2: REBA score

Score	**level of MSD Risk**
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change now

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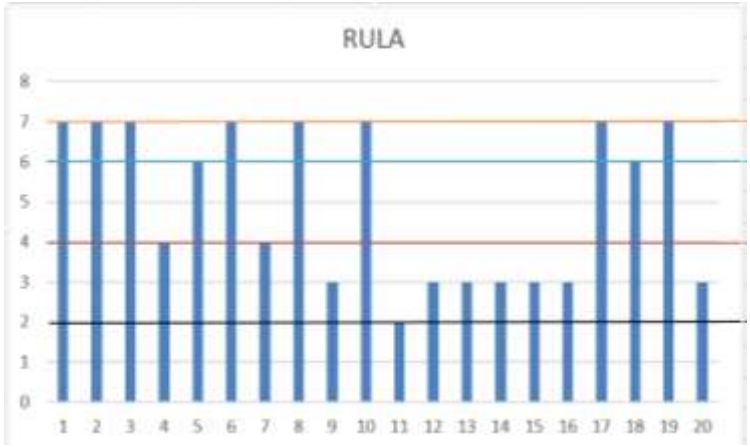

Fig1: RULA scores of tasks before intervention

From the assessment of upper limbs it is quite evident that only one task is in the negligible risk zone.45% of the evaluated tasks were found to be in the low risk zone. Engineering changes are carried out only for the remaining 50% of the tasks which lie in the medium to very high risk zone.

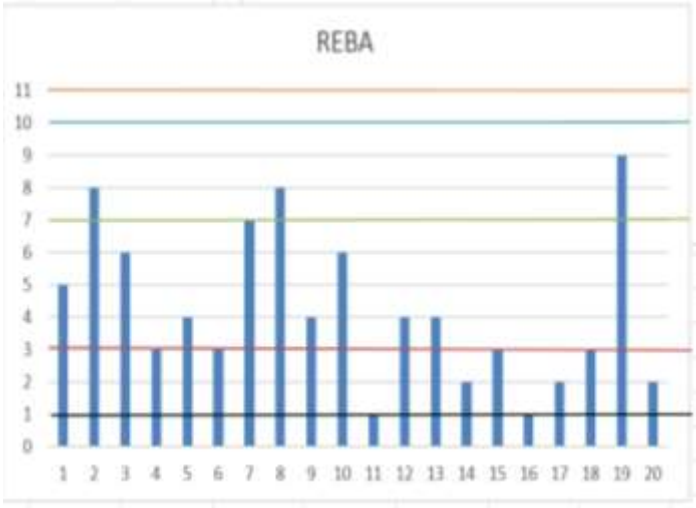

Figure 2: REBA scores of tasks before intervention

The entire body assessment exhibits that no process lies in the very high risk zone.45% of the tasks are found to be in medium risk zone. Only 2 tasks lie in the high risk zone and negligible risk zone.

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Improvements carried out

Table 3: Improvement activity and benefits

TASK	IMPROVEMENT	BENEFIT
Body Loading	Providing electrical winch	4 sec reduction of cycle time, elimination of one member
Manifest attachment	Providing lift assists	Elimination of manual lifting
Boot cover installation	Processing from side on instead of forward position; adapting tool balancer	2 sec reduction of cycle time
I/P loading	Providing pendant controls at waist height	Burden reduction of arms
Vacuum hose assembly	Providing height adjustable seats; adapting tool holder	Burden reduction of arms and trunk
Air duct installation	Avoid kneeling position	Burden reduction of trunk
Weather strip installation	Mechanize the task	Burden reduction of upper limbs
Dust cover assembly	Raising the height of workstation; providing tool holder	Burden reduction of arms and trunk
Seat belt assembly	Adapt tool holder	Burden reduction of arms
Intercooler assembly	Member should stand on the moving conveyor	Provides stable base
Carpet loading	Utilize fixtures; lift from waist height; placing through back door; reorienting loading area	2 sec reduction of cycle time due to reduction in walking.

Results (Post-intervention)

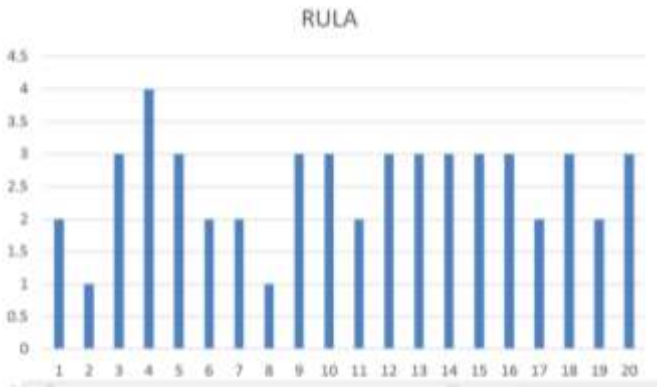

Figure 3: RULA scores of tasks post intervention

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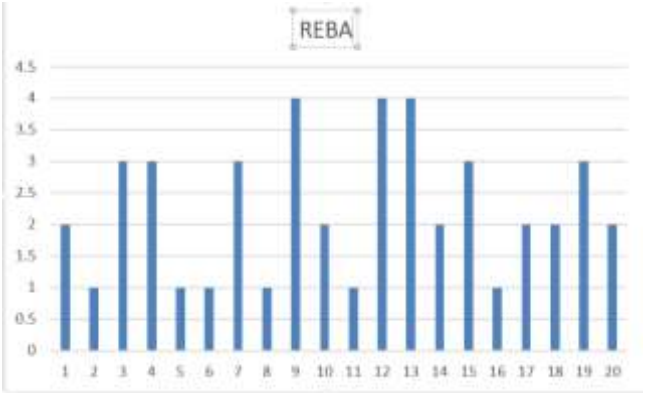

Figure 4: REBA scores of tasks post intervention

Upon implementing the above changes the RULA scores of 25 % of the tasks were found to be in the negligible risk zone from the very high risk zone.2 tasks had dropped down to low risk zone from medium risk zone. Only three tasks were found to be in the medium risk zone in the REBA score. 85% of the tasks settled in the low risk and negligible risk zone.

Conclusions

The risks of musculoskeletal disorders were clearly quantifiable by the postural analysis tools RULA & REBA. 40% of the tasks analysed according to RULA had a very high risk of developing MSD and 45% of the tasks according to REBA had a medium risk of developing MSD. Adapting the improvements mentioned above ensured all the tasks lie in the low and negligible risk zone according to RULA. The REBA scores also reduced 85% of the tasks to within low and negligible risk zone. The improvement activities also reduced the cycle time by 8 seconds and reduction of manpower.

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