Shri Sharad Marutrao Deshpande[1*], Dr. Premanand Janardan Bansod[2]
[1]Mechanical Engineering Department, G H Raisoni College of Engineering and Management, Pune
[2]Mechanical Engineering department, G H Raisoni College of Engineering and Management, Pune

Mental workload assessment of workers working in automobile industries using National Aeronautics and Space Administration-Task Load Index (NASA-TLX) assessment tool.

Abstract: The mental workload of especially disabled employees can be assessed by many assessment tools. NASA-TLX is one such very effective assessment tool. This Research paper highlights the analysis of NASA-TLX methodology used for 14 employees carried out at M/S Kulkarni Engineers, Pune, which is a medium scale industry, supplying automobile components like Brass washers to Automobile industries. The employees under heavy or very heavy mental workload face various issues like lowering working efficiency, fatigue, undue stress and effect on work satisfaction etc. Suitable remedies can be suggested to the Management to bring down the Mental Workload making their working more easy, comfortable, enhancing their efficiency, reducing their fatigue and stress etc.

Key Words

Disabled employees, NASA-TLX, work-load category, Automobile industries.

1. INTRODUCTION

Disabled people can be offered employment considering their limitations. Disabled employees can also perform better if they have given a fair opportunity to prove themselves [1, 2]. Attitude of colleagues toward disabled employees differs for type of their disability [3]. The higher probability of employment and its retention for intellectually disabled employee in industries is associated with many factors like support from the family members, the higher education level and professional skills acquired by disabled employees, matrimonial status etc. [4].

By proper linkage between some typical tool like 5 S of Lean manufacturing and safety and health issues of employees including disabled employees can minimize wastages of the organization in the form of time and money spend on injured employees in the form of their compensation etc. [5]. Offering employment opportunity to disabled people may yield many advantages like enhancing their self-confidence, recognition by society, self-financial dependency, higher profitability to the organization, etc. [6]. Flexible working conditions, redefining the tasks, anti-discriminant culture in the organization can enhance the self-confidence of disabled employees resulting in desired performance for the organizations [7].

Use of computer simulations like discrete event simulation can support the organizations to plan employment for People with disability successfully. It also helps such organizations to build very positive commercial image in market [1]. Employer's attitude towards people with disability depends upon nature of disability, his awareness about corporate social responsibility, method applied by employer for evaluating the work performance by disabled employees etc. [8].

The performance appraisal process for disabled employees should consider factors such as type of disability, job specification etc. Common practice of simply comparing the ratings of employees for performance appraisal must be updated for disabled employees. This is required to avoid the bias in performance appraisal of disabled employees [9]. The issue of different recommendations for hiring disabled people to minimize employer's bias is once again stressed [10]. The disability has high impact on evaluation of employee during selection process [11].

Case study of attitudes of more than 250 Israeli employers showed their acceptance to offer employment to disabled people. This was highly supported by their past experience and readiness to accept disabled employees [12]. People with physical disability are more preferred for employment than people with mental disability[13]. Full time equivalence method implemented in an Indonesian organization for logistics admin employees concluded uneven work load for employees. The workload distribution of the employees doing

same jobs was uneven. Some were overloaded and remaining were having normal workload or were under loaded. It was recommended to review HR policies concerned with workload distribution to all employees. It was also applicable to disabled employees [14].

Increased number of projects handled by any organization results in increased need of expert engineering assistance. Modified full time equivalence method (M-FTE) which also considers the performance rating and allowances assigned by Industrial Engineering department to each employee based upon the task performed by each employee helps to calculate physical workload of each employee. Similarly, the mental workload of each employee is obtained by applying NASA-TLX method and its principles. Physical and mental workloads can be refined for optimum output by replacing manual activities by automatic machines, wherever possible, allowing strictly experienced and skilled employees to handle complex jobs and not allowing inexperienced employees to handle such jobs and employing more required employees, increasing rest times or improving work processes [14].

2. Methodology

Suitable survey question forms were prepared to collect relevant NASA-TLX preliminary data from selected 14 employees of M/S Kulkarni Engineers, Pune. These employees were interviewed face to face to collect data. From this data weighting data for these employees was investigated. During interaction, rating for each employee was also determined.

From this weighting and rating data, product values were calculated. From these product values, final NASA-TLX scores were determined. These scores were compared with NASA-TLX work load categories. It helped to categorize the employees as under high or very high workloads or normal workload.

Remedies to lower mental workload for such employees, such as enhancing ergonomic conditions for such employees, providing tea break etc can be recommended to the management.

Table 1: First sheet of NASA-TLX

Sr No	Measuring dimension	Scale
1	Mental demand	Low to high
2	Physical demand	Low to high
3	Temporal demand	Low to high
4	Performance	Low to high
5	Effort	Low to high
6	Frustation	Low to high

Table 2 : Second sheet of NASA-TLX

Sr No	Paired Scales
1	Performance or Effort
2	Physical demand or Frustration
3	Temporal demand or Frustration
4	Physical demand or Temporal demand
5	Mental demand or Temporal demand
6	Performance or Frustration

3. Work analysis

After collecting the relevant data from all concerned employees, the number of occurances of various indicators namely Mental demand (MD), Physical demand (PD), Temporal demand (TD), Own performance (OP), Effort (EF) and Frustation (FR) are counted. This enables to prepare weightind data of employees. During face to face interaction, rating for each of above indicators is identified.

The product of weighting given and rating for each worker results into product value. By applying the NASA-TLX methodology, the NASA-TLX score for each employee involved in the study is evaluated. This NASA-TLX score can be compared with the workload category recommended by NASA to decide the category of each employee as employee under low, medium, rather high, high or very high mental load.

Table 3: Sample Weighting Data of operators

Sr No	Operator	Indicators						Total
		MD	PD	TD	OP	EF	FR	
1	(Arifuddin)	2	5	3	1	4	0	15
2	Vijay	3	5	2	1	4	0	15

Table 4: Sample Rating Given

Sr No	Operator	Indicators					
		MD	PD	TD	OP	EF	FR
1	Arifuddin	30	100	80	20	90	30
2	Vijay	60	90	40	30	80	10

Table 5: Sample product value calculation

Sr No	**Operator**	**Indicator**	**Weight**	**Rating**	**Product**
1	Arifuddin	MD	2	30	60
		PD	5	100	500
		TD	3	80	240
		OP	1	20	20
		EF	4	90	360
		FR	0	30	0

4. Results

After determining the weighting and rating for each employee under study, product value for each such employee is calculated. The final NASA-TLX score for each employee can be determined from product value by using recommended NASA-TLX methodology. These NASA-TLX scores will highlight the workers under high and very high mental workload. Suitable remedies such as improved ergonomics, providing required additional manpower can be recommended to the management to reduce the mental workload for such employees which finally can help the industry to have better productivity.

Table 6: NASA-TLX Scores

Sr No	**Operator**	**NASA -TLX Score**
1	Arifuddin	78.6
2	Vijay	70.6
3	Pundlik	70
4	Dhananjay	70
5	Vinod	67.3
6	Hanumant	68.6
7	Rupesh	66.6
8	Karamat Ali	70.6
9	Lakhan	66
10	Chandrakant	74
11	Dinesh	72
12	Vibeck	70
13	Raju	70.6
14	Mubarak	69.33

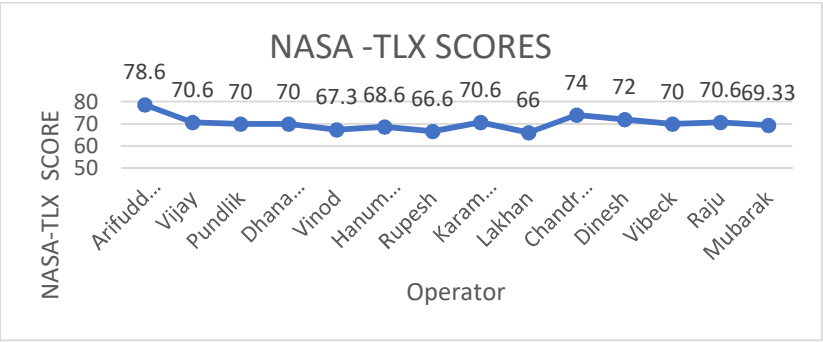

Fig 1: NASA-TLX Scores of operators

Table 7: NASA-TLX Work Load Categories.

Work load category	Value
Low	0-9
Medium	10-29
Rather High	30-49
High	50-79
Very High	80-100

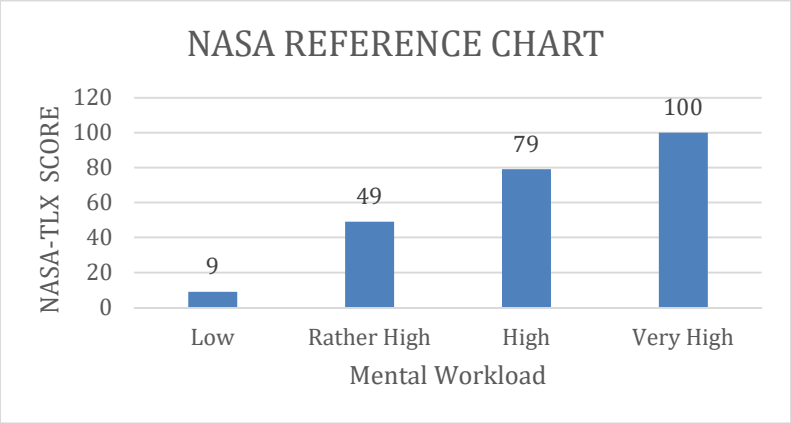

Fig 2. NASA-TLX workload categories.

5. Conclusion

- NASA-TLX methodology is implemented to determine NASA-TLX scores for the 14 operators.
- As per NASA-TLX workload category, all the 14 operators are under high mental workload.
- These operators can face fatigue resulting in lowered work efficiency, organizational productivity etc.
- Suitable corrective measures by management such as better ergonomic at workstations, counselling of these operators, providing additional man-power at required work-stations can help to reduce mental workload.
- The organization will also be benefited through improved productivity.

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