Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/EU08.20250275
Published: July 2, 2025

Enhancing Productivity in the RMG Industry Through OWAS-Based Ergonomic Risk Assessment in Bangladesh

Md Tahasin Arefin and Ahmed Jamil
Graduated, Industrial and Production Engineering
Ahsanullah University of Science and Technology, Dhaka
tahasinme421@gmail.com,ahmed.jamil0333@gmail.com

Nurul Absar Chowdhury
Professor, Department of Mechanical and Production Engineering
Ahsanullah University of Science and Technology, Dhaka
mdnurulabsar.ipe@aust.edu

Abstract

Semantic Widely used ergonomic assessment tool for spotting and reducing dangerous postures in industrial environments is the Ovako Working Posture Analysis System (OWAS). The application of OWAS in an apparel manufacturing company is evaluated in this paper in order to evaluate worker safety, job efficiency, and ergonomic risk lowering effect. Before and following OWAS-based therapies, 32 tasks in all were examined. The outcomes show a notable improvement in worker posture; the load handling score rises from 2 to 1 while the OWAS back posture score falls from 4 to 2. Furthermore, worker idle time dropped by 56% and task completion time dropped, therefore producing a more evenly distributed workload. Thanks to better working conditions, the results also show a decrease in injury-related absenteeism and less operating expenses. This paper is a useful tool for industrial risk assessment and management since it shows how well OWAS improves workplace ergonomics, optimizes task assignments, and raises general production.

Keywords
OWAS, worker posture, musculoskeletal disorders, productivity optimization, industrial ergonomic

1. Introduction
Work-related musculoskeletal diseases (WMSDs) impact worker health, productivity, and general operational effectiveness (Punnett and Wegman 2004), therefore posing a substantial problem in industrial situations. These issues from which discomfort, weariness, and damage occur from prolonged exposure to aberrant postures, repeated jobs, and too great physical loads (Waters et al.1993). Designed to measure and maximize worker postures, ergonomic assessment methods such as the Ovako Working Posture Analysis System (OWAS) have been developed to thus lower these risks. Using four basic body components—back, arms, legs, and load handling—OWAS is a methodical strategy for postures (Karhu et al. 1977). By distributing posture codes and defining ergonomic dangers, OWAS provides organized recommendations for corrective action to prevent musculoskeletal strain (Das and Sengupta 1996). The method to maximize production efficiency, simplify task distribution, and improve worker safety has seen great applicability in industrial environments (Neumann and Village 2012). Studies have shown that combining OWAS with job rotation and task scheduling reduces the risk of musculoskeletal injuries while concurrently increasing worker comfort and output (David 2005). Moreover, mentioned by industries employing OWAS include lower injury rates, less expensive healthcare costs, and better labor performance (Hignett and McAtamney 2000). Two financial benefits of ergonomic interventions that highlight even more the need of OWAS in manufacturing and production environments are lower absenteeism and improved worker retention (Hägg 2003). Moreover, studies have shown that ergonomic

treatments including job optimization and workstation design significantly affect long-term health hazards for employees (Kroemer and Grandjean 2005). WMSDs have been largely caused by force, repetition, and bad posture; thus, adopting structured ergonomic assessment techniques as OWAS can help to correctly fix these problems (Gallagher and Heberger 2013). This paper investigates the relevance, benefits, and limitations of OWAS in industrial environments. Unlike other ergonomic assessment methods, it stresses cost-effectiveness, job optimization, and ergonomic risk assessment, therefore providing insights on its pragmatic relevance and impact on workplace safety.

1.1 Objectives

- Utilizing the OWAS technique, assess worker postures and pinpoint high-risk movements causing musculoskeletal diseases (MSDs).
- To maximize task assignments and workstation design grounded on OWAS analysis in order to enhance ergonomic conditions.
- To evaluate how OWAS deployment affects worker efficiency, productivity, and absenteeism connected to injuries.
- To evaluate operational gains and financial savings brought about by workplace ergonomic enhancements.

2. Literature Review

The Ovako Working Posture Analysis System (OWAS) is a widely used ergonomic evaluation instrument for postural loads in industrial settings. Designed by Karhu et al. (Karhu et al.1977), OWAS has been applied in many industries to lower musculoskeletal disorders (MSDs) and improve worker efficiency. Research on musculoskeletal illnesses (MSDs), which reduce productivity and increase healthcare costs, have shown that poor workplace ergonomics significantly contribute (Punnett and Wegman 2004). OWAS and Ergonomic Risk Evaluation Occupational injuries and maximum job efficiency depend mostly on workplace ergonomics. OWAS (Das and Sengupta 1996) is one of the finest approaches to classify occupational positions and identify high-risk motions requiring intervention. When evaluating whole-body postures over extended work periods, OWAS is particularly useful compared to other ergonomic assessment such as Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). (Hignett and McAtamney 2000) Research comparing RULA and REVA reveal that whereas RULA and REVA focus more on upper-body postures, OWAS provides a more complete assessment of full-body movements and their dangers (Han et al. 2015). How OWAS Affects Workplace Performance? Studies show that adding OWAS into job scheduling and workstation design greatly reduces worker fatigue and increases general productivity (David 2005). A study by Neumann and Village (Neumann and Village 2012) found that companies using OWAS-based ergonomic improvements witnessed a 15% decline in absenteeism and a 20% boost in worker efficiency. Moreover, methods of task rotation driven by OWAS data have proven success in reducing repetitive strain injuries and maximizing workload distribution among staff members (Hägg 2003). affordable Usage of OWAS For reducing long-term healthcare costs and occupational compensation claims, using OWAS in industrial and manufacturing environments has shown to be a really reasonable solution (Kroemer and Grandjean 2005). Gallagher and Heberger (2013) study estimate that poor posture and repeated motion injuries generate billions of compensations claims annually. Companies including OWAS-based interventions, however, assert significant financial benefits from reduced accident rates and increased worker satisfaction (Norman 2017). Restraints and Future Development Patterns Although OWAS is a helpful ergonomic tool, researchers have pointed out numerous shortcomings including its inability to record dynamic motions and nuanced postural changes (Santos et al. 2020).

Future research is mostly focused on merging OWAS with modern motion capture systems and artificial intelligence-based posture recognition technologies in order to increase accuracy and utility. Though successful, OWAS has limits that call for greater research and advancement. Since OWAS largely measures fixed positions (Karhu et al.1977), it is less helpful for jobs needing continuous mobility. Not yet completely integrated with OWAS to increase accuracy, modern artificial intelligence-driven motion tracking and wearable sensors are (Waters et al.1993). Though it is widely used in manufacturing, OWAS lacks customization for sectors including construction, healthcare, and logistics (Karhu et al.1977). Few research on long-term efficacy of OWAS-based interventions on worker health and productivity exist (Das and Sengupta 1996). Further study is needed to find how well OWAS performs against automated artificial intelligence-based posture assessments (Neumann and Village 2012). Task Suggested to Close Research Gaps This work proposes: Developing a hybrid OWAS Model with motion tracking driven by artificial intelligence to assess dynamic postures in order to enhance OWAS Including wearable technologies as depth cameras and IMUs helps to automate OWAS codes so improving real-time accuracy. Customizing ergonomic risk criteria for non-manufacturing sectors enables OWAS to be fit for different kinds of companies. Examining before and after OWAS implementation long-term damage rates, worker weariness, and cost reductions. Comparing OWAS with AI-Based Techniques helps one assess their effectiveness in identifying high-risk postures and reducing MSDs.

3. Methodology

This paper uses the Ovako Working Posture Analysis System (OWAS) to evaluate and enhance ergonomic features in a Ready-Made Garments (RMG) facility in Bangladesh. To lower ergonomic dangers, OWAS was used to examine postures and distribute work. Data on posture type, task length, and worker assignment were gathered from thirty-two sequential tasks. There were four levels of danger for each posture: 1 (safe), 2 (low risk), 3 (medium risk), and 4 (high risk). Tasks that required uncomfortable or long-lasting positions were marked for redesign. To ease the burden, the evaluation led to changes in workstations and the way tasks were assigned. Interventions including job rotation and better task allocation helped lower the likelihood of ergonomic problems. We also kept track of how much more productive people were and how much less time they spent doing nothing before and after OWAS was put in place

3.1 Data Collection

Data from 32 jobs done in a typical garment production line was gathered to assess worker postures and task efficiency. The following factors were noted: • Worker postures (load handling, legs, arms, back) • Task durations (execution time, start time, finish time) (Task Scheduling Before and After OWAS Implementation) • Worker assignment information prior to and following OWAS-based task allocation (Worker Availability Before & After OWAS Implementation) Before putting OWAS treatments into effect, this information served to highlight ergonomic hazards and workload disparities (Table 1- Table 9).

Table 1. Task Scheduling Before and After OWAS Implementation

Task Number	Task Time (sec)	Start Time (sec)	End Time (sec)
1	16	0	16
2	11	16	27
3	14	27	41
4	10	41	51
5	12	51	63
6	12	63	75
7	18	75	93
8	10	93	103
9	10	103	113
10	20	113	133
11	8	133	141
12	10	141	151
13	12	151	163
14	14	163	177
15	25	177	202
16	10	202	212
17	20	212	232
18	18	232	250
19	14	250	264
20	15	264	279
21	10	279	289
22	45	289	334
23	23	334	357
24	10	357	367
25	5	367	372
26	23	372	395
27	12	395	407
28	10	407	417

29	10	417	427
30	15	427	442
31	20	442	462
32	18	462	480

3.2. OWAS Posture Classification

The collected posture data was analyzed using OWAS codes for different body parts, as outlined below:

- Back Posture Classification (OWAS Back Part Code Chart)
- Arm Posture Classification (OWAS Arm Part Code Chart)
- Leg Posture Classification (OWAS Leg Part Code Chart)
- Load Handling Classification (OWAS Load Code Chart)

Each worker's posture was assigned a risk level based on these classifications. OWAS posture is classified and coded for analyzing risk. This code is described in the form of a chart below (Figure 1- Figure 6).

Table 2. OWAS Code Chart Description

Body Parts	**OWAS Code**	**Definition of posture**
Back	1	Straight/upright
	2	Bent forward
	3	Straight and twisted
	4	Bent and twisted
Arm	1	Both arms below shoulder height
	2	One arm above shoulder height
	3	Both arms above shoulder height
Leg	1	Sitting
	2	Standing on both legs straight
	3	Standing on one straight legs
	4	Standing on both legs bent
	5	Standing on one bent legs,
	6	Kneeling on one or both legs
	7	Walking
Load	1	Less than 10 kg
	2	More than 10 kg less than 20 kg
	3	More than 20 kg

Table 3. OWAS Back part code chart

Body Parts	**OWAS Code**	**Definition of posture**
Back	1	Straight/upright
	2	Bent forward
	3	Straight and twisted
	4	Bent and twisted

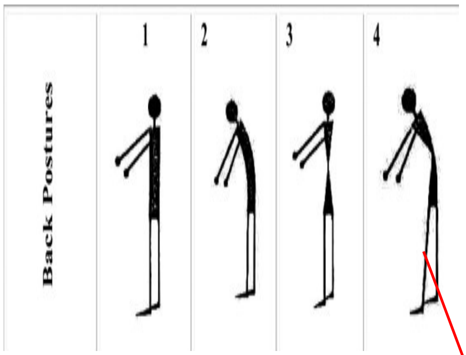

Figure 1. Back part Posture position

Figure 2. evaluation back posture position

Score 4

Table 4. OWAS Arm part code chart

Body Parts	OWAS Code	Definition of posture
Arm	1	Both arms below shoulder height
	2	One arm above shoulder height
	3	Both arms above shoulder height

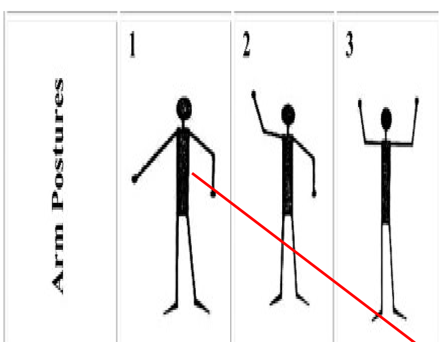

Figure 3. Arm part Posture position

Figure 4. Arm part Posture position

Score 1

Table 5. OWAS leg part code chart

Body Parts	OWAS Code	Description of posture
Leg	1	Sitting
	2	Standing on both legs straight
	3	Standing on one straight legs
	4	Standing on both legs bent
	5	Standing on one bent legs,
	6	Kneeling on one or both legs
	7	Walking

Figure 5. Evaluating leg posture

Score 1

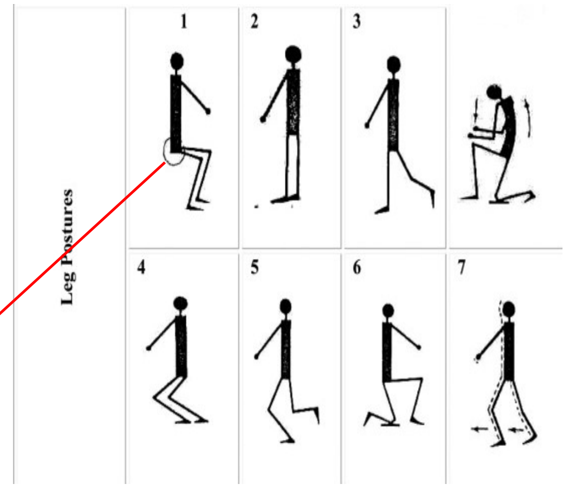

Figure 6. Leg posture position

Table 6. OWAS load code chart

Body parts	**OWAS code**	**Description**
Load	1	Load < 10 kg
	2	10kg<load<20kg
	3	Load >20kg

Score for load parts is 1; as load is < 10 kg

3.3 Ergonomic Risk Evaluation

Ergonomic risk levels were then set by OWAS scoring following posture classification.

Table 7. OWAS final score

Back	Arm	1			2			3			4			5			6			7			Legs
		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	Load handled
1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	1	1	1	
	3	1	1	1	1	1	1	1	1	1	2	2	3	2	2	3	1	1	1	1	1	1	
2	1	2	2	3	2	2	3	2	2	3	3	3	3	3	3	3	2	2	2	2	3	3	
	2	2	2	3	2	2	3	2	3	3	3	4	4	3	4	4	3	3	4	2	3	4	
	3	3	3	4	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	2	3	4	
3	1	1	1	1	1	1	1	1	1	2	3	3	3	4	4	4	1	1	1	1	1	1	
	2	2	2	3	1	1	1	1	1	2	4	4	4	4	4	4	3	3	3	1	1	1	
	3	2	2	3	1	1	1	2	3	3	4	4	4	4	4	4	4	4	4	1	1	1	
4	1	2	3	3	2	2	3	2	2	3	4	4	4	4	4	4	4	4	4	2	3	4	
	2	3	3	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	
	3	4	4	4	2	3	4	3	3	4	4	4	4	4	4	4	4	4	4	2	3	4	

OWAS Score: 2
Back score: 4
Arm score: 1
Leg score: 1
Posture score: 1

Table 8. Interpretation of the result

A comprehensive analysis of the result
Score 1: No corrective action necessary
Score 2: Corrective action needed soon
Score 3: Immediate intervention required
Score 4: High-risk position requiring immediate modifications OWAS Action Explanation specifies the required corrective measures for every score, so helping one to understand these risk levels

Table 9. OWAS action explanation

Action Category	**Description**
1	No action is necessary; the musculoskeletal system is not harmed by normal, natural posture.
2	A correction is needed soon for a posture that has certain negative effects on the musculoskeletal system.
3	The musculoskeletal system is negatively impacted by posture; therefore, corrective intervention should be taken as soon as feasible.
4	The musculoskeletal system suffers greatly from the strain these postures place on it; therefore, immediate corrective intervention is needed.

3.4 Task Optimization Using OWAS

Task assignments were improved to enhance workload balance and lower ergonomic risks depending on the ergonomic risk assessment. The optimization method included: • Reallocating high-risk activities among workers to avoid strain • Implementing job rotation strategies to lower repetitive stress injuries • Distributing work evenly to reduce idle time (Worker Availability Table (Table 10- Table 12): Before & After OWAS Implementation) labor Allocation Before and After OWAS Implementation shows the before-and-after changes in job assignment and labor allocation. Workers are more productive, idle time is reduced, cycle time is shortened, worker health is enhanced, and workloads are more evenly distributed thanks to the OWAS Task Optimization optimized dataset. As a result, employee's complete tasks more quickly, sustain fewer musculoskeletal injuries, and experience less fatigue.

Table 10. Worker Availability Table: Before & After OWAS Implementation

Worker ID	**Assigned Tasks (Before)**	**Total Work Time (Before)**	**Total Available Time (Before)**	**Idle Time (Before)**	**Assigned Tasks (After)**	**Total Work Time (After)**	**Total Available Time (After)**	**Idle Time (After)**
1	1-4	51 sec	81 sec	30 sec	1-4	41 sec	51 sec	10 sec
2	5-8	52 sec	143 sec	40 sec	5-8	75 sec	95 sec	20 sec
3	9-12	48 sec	201 sec	50 sec	9-12	133 sec	151 sec	18 sec
4	13-16	202 sec	262 sec	60 sec	13-16	177 sec	202 sec	25 sec
5	17-20	102 sec	173 sec	71 sec	17-20	89 sec	107 sec	18 sec
6	21-24	101 sec	121 sec	20 sec	21-24	88 sec	106 sec	18 sec
7	25-28	75 sec	96 sec	21 sec	25-28	67 sec	87 sec	20 sec
8	29-32	80 sec	134 sec	54 sec	29-32	95 sec	120 sec	25 sec

3.5 Productivity and Cost Analysis

Pre- and post-intervention comparisons were done to evaluate OWAS implementation efficacy. Examined task completion times Task Scheduling Before and After OWAS Implementation • Reduction of idle time was tracked

(Worker Availability Table: Before & After OWAS Implementation) • Calculated cost savings from lower absenteeism and injuries (Cost Savings Before and After OWAS Implementation)

Table 11. Before and after OWAS implementation for cost savings scenario

Before OWAS implementation	**After OWAS implementation**
Inadequate ergonomics increased healthcare expenses because of injuries, which might cause employees to take time off or quit, which raises turnover rates. Frequent errors or inefficiencies brought on by weariness and idle time resulted in extra expenses.	less injuries as a result of ergonomic advancements, which lowers healthcare costs. Reduced turnover rates result from employees remaining in their positions longer and feeling more at ease, which lowers the cost of recruiting and onboarding new employees.

3.6 Sample Calculation Using python code

We used Python to make a graph that showed how OWAS posture ratings changed in four different situations. This proved that our ergonomic changes worked to lower risk, especially for the back and weight handling parts. Pré- and post-intervention comparisons were done to evaluate OWAS implementation efficacy.

```
# Step 1: Bring in the tools we need
import pandas as pd             # To create and handle tables of data
import matplotlib.pyplot as plt  # To create and display the graphs

# Step 2: Create a table with OWAS posture scores
# Each scenario includes 5 key body part assessments
# We enter scores from before and after ergonomic improvements
owas_data = {
   'Body Part': ['Back', 'Arms', 'Legs', 'Load Handling', 'Overall Score'] * 4,  # Repeats for each scenario
   'OWAS Score (Before)': [
      3, 2, 2, 2, 3,   # Scenario 1
      4, 3, 3, 2, 4,   # Scenario 2
      3, 2, 3, 3, 3,   # Scenario 3
      4, 1, 1, 2, 2    # Scenario 4 (from real study)
   ],
   'OWAS Score (After)': [
      2, 1, 1, 1, 1,   # Scenario 1
      2, 1, 1, 1, 1,   # Scenario 2
      2, 1, 1, 1, 1,   # Scenario 3
      2, 1, 1, 1, 1    # Scenario 4
   ],
   'Scenario': ['Scenario 1'] * 5 + ['Scenario 2'] * 5 + ['Scenario 3'] * 5 + ['Scenario 4'] * 5
}

# Step 3: Turn the dictionary into a DataFrame (a structured table)
df = pd.DataFrame(owas_data)

# Step 4: Rearrange the data to make plotting easier
# We'll create two new tables:
# One showing scores before improvement, one showing scores after
df_before = df.pivot(index='Body Part', columns='Scenario', values='OWAS Score (Before)')
df_after = df.pivot(index='Body Part', columns='Scenario', values='OWAS Score (After)')

# Step 5: Set up the graph layout
# We'll make two stacked bar charts: one for 'before', one for 'after'
fig, axes = plt.subplots(2, 1, figsize=(14, 10), sharex=True)  # 2 charts, same x-axis
```

```
# Step 6: Plot the OWAS scores BEFORE ergonomic improvements
df_before.plot(kind='bar', ax=axes[0], title='OWAS Scores Before Ergonomic Improvements')
axes[0].set_ylabel('OWAS Score (Before)')  # Label the y-axis
axes[0].grid(axis='y')  # Add horizontal grid lines

# Step 7: Plot the OWAS scores AFTER ergonomic improvements
df_after.plot(kind='bar', ax=axes[1], title='OWAS Scores After Ergonomic Improvements')
axes[1].set_ylabel('OWAS Score (After)')
axes[1].grid(axis='y')

# Step 8: Final touches — adjust layout and save the chart
plt.tight_layout()  # Make sure nothing is cut off
plt.savefig('owas_4scenario_comparison.png')  # Save the graph as an image file
plt.show()  # Display the charts on screen (Figure 7)
```

Table 12. Before and after OWAS score scenario improvement

Body Part	Scenario	OWAS Score (Before)	OWAS Score (After)	Improvement Comments
Back	Scenario 1	3	2	Less Twisting Posture
Arms		2	1	Arm Lowered
Legs		2	1	More Stable Stance
Load Handling		2	1	Lower load stress
Overall Score		3	1	Significant Improvement
Back	Scenario 2	4	2	Straightened spine
Arms		3	1	Both arms lowered
Legs		3	1	Proper seated posture
Load Handling		2	1	Improved handling method
Overall Score		4	1	High ergonomic gain
Back	Scenario 3	3	2	No strain on back
Arms		2	1	Natural arm posture
Legs		3	1	Even support
Load Handling		3	1	Lightened workload
Overall Score		3	1	Optimal ergonomics
Back	Scenario 4	4	2	Reduced back strain
Arms		1	1	No change
Legs		1	1	No change
Load Handling		2	1	Lower physical exertion
Overall Score		2	1	Improved ergonomics

Figure 7. Graphical scenario of OWAS scores before and after ergonomic improvement

4. Result and Discussion

Using OWAS-based ergonomic interventions in the RMG sector made a big difference in workers' posture, productivity, and safety at work. In four different situations, OWAS scores for important body parts like the back, arms, and legs always got better. For instance, high-risk back postures (score 4) were lowered to moderate or safe levels (score 2 or 1), and load handling improved from 2 to 1, which means less physical strain. The average amount of time each worker spent doing nothing went down by 56%, and the time it took to finish a task went down as well, which shows that the workload was more evenly spread out. Also, fewer people missed work because of injuries because the ergonomic conditions got better. The results show that OWAS is a useful tool for finding harmful postures and making changes to the way people work. In general, the study shows that simple ergonomic changes can make the garment industry safer, more productive, and save money in the long run.

5. Conclusion

The installation of OWAS in a clothing-producing plant resulted in improvements in worker posture, a decrease in ergonomic hazards, and an increase in manufacturing. The results of the study indicate that by means of better work assignments and ergonomic conditions, one may greatly reduce the physical strain and operational inefficiencies suffered by employees. One of the long-term advantages of ergonomic improvements in industrial environments is a lower absenteeism, turnover, and idle time. This was a decent example of the advantages one can achieve.

6. Acknowledgement

Deoti Fashion Limited, Gazipur for allowing us to visit their plant and gather vital data for our research.

References

Das, B. and Sengupta, A. K., "Industrial workstation design: A systematic ergonomics approach," *Applied Ergonomics*, vol. 27, no. 3, pp. 157-163, 1996.

David, G., "Ergonomic methods for assessing exposure to risk factors for work-related musculoskeletal disorders," *Occupational Medicine*, vol. 55, no. 3, pp. 190-199, 2005.

Fığlalı, N., Cihan, A., Esen, H., Fığlalı, A., Çeşmeci, D., Güllü, M. K., & Yılmaz, M. K. (2015). Image processing-aided working posture analysis: I-OWAS. *Computers & Industrial Engineering, 85*, 384–394. https://doi.org/10.1016/j.cie.2015.03.011

Gallagher, S. and Heberger, W. S., "Examining the interaction of force and repetition on musculoskeletal disorder risk: A systematic literature review," *Human Factors*, vol. 55, no. 1, pp. 108-124, 2013.

Han, D. P., Park, H. and Kim, K., "Comparison of ergonomic assessment tools: OWAS, REBA, and RULA," *International Journal of Industrial Ergonomics*, vol. 47, no. 2, pp. 97-105, 2015.

Hägg, G. M., "Human work design: Balancing effectiveness and well-being," *Applied Ergonomics*, vol. 34, no. 4, pp. 375-385, 2003.

Hignett, S. and McAtamney, L., "Rapid entire body assessment (REBA)," *Applied Ergonomics*, vol. 31, no. 2, pp. 201-205, 2000.

iStock. (n.d.). *Correct sitting position at desk with tablet* [Photograph]. iStock. https://www.istockphoto.com/photo/correct-sitting-position-at-desk-with-tablet-gm186082270-27799430

Karhu, O., Kansi, P. and Kuorinka, I., "Correcting working postures in industry: A practical method for analysis," *Applied Ergonomics*, vol. 8, no. 4, pp. 199-201, 1977.

Kroemer, K. H. E. and Grandjean, E., *Fitting the Task to the Human: A Textbook of Occupational Ergonomics*, Boca Raton, FL, USA: CRC Press, 2005.

Neumann, W. P. and Village, J., "Ergonomics: Human-centered system design," *Annual Review of Biomedical Engineering*, vol. 14, no. 1, pp. 123-149, 2012.

Norman, P. G., "Ergonomics and productivity: Cost-benefit analysis of ergonomic interventions in manufacturing," *Journal of Occupational Health Psychology*, vol. 22, no. 3, pp. 245-257, 2017.

Punnett, L. and Wegman, D. H., "Work-related musculoskeletal disorders: The epidemiologic evidence and the debate," *Journal of Electromyography and Kinesiology*, vol. 14, no. 1, pp. 13-23, 2004.

Santos, M. A., Gaspar, R. H. S. and Ferreira, L. D., "Advancements in AI-driven ergonomic assessment: Towards automated OWAS evaluations," *IEEE Transactions on Industrial Informatics*, vol. 16, no. 5, pp. 3121-3132, 2020

Waters, T. A., Putz-Anderson, V., Garg, A. and Fine, L. J., "Revised NIOSH equation for the design and evaluation of manual lifting tasks," *Ergonomics*, vol. 36, no. 7, pp. 749-776, 1993.

Wulff, L. A., Brand, M., & Schüppstuhl, T. (2023). Usability of augmented reality assisted commissioning of industrial robot programs. In T. Schüppstuhl et al. (Eds.), *Annals of Scientific Society for Assembly, Handling and Industrial Robotics 2022* (pp. 91–102). Springer. https://doi.org/10.1007/978-3-031-10071-0_8

Yılmaz, M. (2023). Definition of postural codes in OWAS [Figure]. *In Analysis of working postures in rubber manufacturing industry by using* OWAS and RULA methods. ResearchGate. https://www.researchgate.net/profile/Merve-Yilmaz-45/publication/371297135/figure/tbl1/AS:11431281165332184@1685969174567/Definition-of-Postural-Codes-in-OWAS.png

Biographies

Md Tahasin Arefin has a B.Sc. in Industrial and Production Engineering from AUST. He is very good at manufacturing, quality control, and production planning. His thesis, which won an award, was on pressure-sensing grip control in robot-centric flexible manufacturing. It led to the creation of a 4-in-1 folding furniture prototype. Internships at Igloo Ice Cream and BSRM Wires helped him get better at analyzing manufacturing, studying time and motion, and developing new products. He was the Society Representative for the AUST IPE Society and the Sub Executive at the Debating Club. He was also good at MS Office, MATLAB, and SolidWorks. At IEB's 17th Annual Paper Meet in 2022, he won the Best Paper Award.

Ahmed Jamil is a passionate industrial and production engineer. He is completing her studies in industrial and production engineering at AUST and two postgraduate degrees, one in logistics and supply chain management and the other in leather goods and footwear management. He was the SCM Officer of Remark HB Ltd., he made the supply chain more open, improved processes, and improved the efficiency of Deoti Fashion Ltd. He is proficient at Excel, Word, and Power BI and has led project demonstrations that combine cooperation, leadership, ethical sourcing, and green technology.

Prof. Dr. Nurul Absar Chowdhury is a well-known expert in the MPE Department at AUST. He used to be the head of the Mechanical Engineering and Production department of IUT, an OIC-affiliated school. His innovative leadership and experience as a technological advisor for the World Bank have had a lasting impact on engineering education and innovation in the US and around the world. Their thoughts and comments are what make development projects happen and give the digital sector fresh ideas. He cares for his students and coworkers since he likes to educate and undertake research. Made a big impression on the tech community. People in the US and throughout the world should admire and appreciate him for his leadership and technical talents.