The Analysis of Factors Related to Unsafe Acts on Welders in XYZ Ltd

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Abstract— *Unsafe acts are diverge actions different from widely acknowledged as safe acts in performing some work. These actions could lead to increasing of likelihood accidents. XYZ Ltd. is a transportation manufacturing company. In 2014, an occupational accident occurred in this company. The aim of this study was to analyze correlation among individual characteristics, work factors, and work stressors, with unsafe acts in production unit at XYZ Ltd. This study used quantitative approach with a cross sectional study design which was conducted in February until March 2016. The results found from 43 respondents were 20 respondents conducted safe acts while 23 of them did unsafe act. From bivariate analysis, it was discovered that there were correlation between individual characteristic factors (age, work peiod, personality type) and unsafe acts, there was correlation between work stressors (interpersonal relationship) and unsafe acts. Finally, there was correlation between work factors (Leadership and Supervision aspects, Engineering, Purchasing, Work Standard, Excessive Wearand Tear, Abuse or Misuse) and workers' unsafe acts.Furthermore, logistic regression analysis was conducted together with sub variables discovered that there was strong significant correlation between exsecive wear and tear and unsafe acts (P-value 0.001 with $\alpha < 0.05$). It is recommended that the management should create safety environment. In addition, socialization of SOP should be encouraged for welders, support of the management in providing OHS facility for welders and adequate supervision of PPE use. Also, empower of personnel supervisor of each unit in the field as OHS supervisory personnel.*

Keywords— Unsafe Acts, Respondent's Characteristics, Work Stressors, Work Factors.

I. INTRODUCTION

XYZ Ltd. as a state-owned company in strategic industry is a world-class transportation manufacturing company. Welding is the main activity which produces fumes, dusts, vapors, and gases including ozone. In 2014, an occupational accident occurred in this company. Prior survey showed that 75% of 20 welders suffering from chronic cough. Other occupational accidents including: welding particles were accidentally pierced into eyes of the welders, conjunctivitis due to welding ray have been reported by the welders after work. Results of other observations found that the welders did not use complete personal protective equipment, they performed welding nearby other welders who were painting, their positions were not ergonomic while welding, they did not use protected curtain while welding.

Because welding produces high risk contaminant which could harm short or long term health, the best ways to decrease its hazardous potentials are by controlling exposure of potential welding gas and fume, recognizing and understanding factors which influence exposure of potential welding gas and fume on welders. The aim of this study was to analyze factors related to unsafe acts on welding unit in XYZ Ltd.

II. METHODS

This study was conducted in welding unit XYZ Ltd. on February until March 2016. This study used quantitative approach. Based on data collection, this study was an observational study with 48 workers as its population and 43 workers as its samples.

Variables in this study included independent variables, such as: work stressor factors (work load, content and control, role demand, management styles, career issues, interpersonal relationship, environment condition factors), work factors (leadership and supervision aspects, Engineering, Purchasing, Maintenance, Work Standard, Excessive Wear and Tear, Tool and Equipment, Abuse or Misuse) with unsafe acts. Bivariate analysis and Analysis of binary logistic regression were utilized to answer the influence of independent variables (predictors) on unsafe acts (responsive variables).

III. RESULT

3.1 Correlation between workers' characteristic factors (Age, Work Period, Welding Trainings, OHS Trainings and Personality Type) and workers' unsafe acts

Based on table 3.1., unsafe acts were performed by workers age 35-44 years old (16.28%) and age 45-54 years old (37.21%). Based on work period, unsafe acts

were frequently conducted by workers with 12-26 years work period (51.16%)

Table.3.1: Correlation Worker's Characteristic Factors with Worker's Unsafe Acts

Workers' Characteristic Factors	Dependent Variables: Workers' Behavior				Total		Association Coefficient	Score Sign. (2-tailed)	Conclusion
	Safe		Unsafe						
	N	%	N	%	N	%			
Age									
15 – 24 y.o	1	2.3	0	0	1	2.3	0.477	0.005	Significant
25 – 34 y.o	6	14	0	0	6	14.0			
35 – 44 y.o	8	17.62	7	16.28	15	34.9			
45 – 54 y.o	5	11.59	16	37.21	21	48.8			
≥ 55 y.o	0	0	0	0	0	0			
Work Period									
< 12 years	7	16.30	0	0	7	16.30	0.437	0.006	Significant
12– 26 years	13	30.24	22	51.16	35	8.40			
> 26 years	0	0	1	2.30	1	2.30			
Personality Type									
Conscientiousness	15	34.85	6	13.95	21	48.8	0.484	0.004	Significant
Neuroticism	3	7	9	20.9	12	27.9			
Openness to Experience	1	2.3	0	0	1	2.3			
Agreeableness	1	2.3	8	18.7	9	21			
Extraversion	0	0	0	0	0	0			
Trainings									
OHS and welding Trainings	17	39.49	20	46.51	37	86	0.484	0.853	Insignificant
OHS or welding Training	3	7	3	7	6	14			
Never	0	0	0	0	0	0			

Based on personality type, unsafe acts could be performed by workers who have Neuroticism character (20.93%). Also, based on trainings participation, unsafe acts were conducted by workers who had participated in OHS and welding trainings (46.51%).

3.2 Correlation between work stressors (work load, content and control, role demand, management style, career issues, interpersonal relationship, environment condition factors) and unsafe acts

Table 3.2. depicts that fair-level of work load stressor correlated with unsafe acts (25.58%). Furthermore, fair-level of content and control stressor correlated with unsafe acts (20.93%). Additionally, fair-level of role demand stressor correlated with unsafe acts (39.53%). Then, fair-level of management style stressor correlated with unsafe acts (25.58%). In addition, fair-level of career issue stressor correlated with unsafe acts (25.58%). It was followed by fair-level of environment condition stressor correlated with unsafe acts on (27.91%). Lastly, fair-level of interpersonal relationship stressor correlated with unsafe acts (51.16%).

Table.3.2: Correlation Work Stressors with Workers' Unsafe Acts

Independent Variables: Work Stressors	Dependent Variables: Workers' Unsafe Acts				Total		Association Coefficient	Score Sign. (2-tailed)	Conclusion
	Safe		Unsafe						
	N	%	N	%	N	%			
Work Load							0.286	0.147	Insignificant
a) Easy	5	11.63	6	13.95	11	25.58			
b) Fair	14	32.56	11	25.58	25	58.14			
c) Hard	1	2.33	6	13.95	7	16.28			
Content and control							0.343	0.056	Insignificant
a) Easy	1	2.33	8	18.60	9	20.93			
b) Fair	11	25.58	9	20.93	20	46.51			
c) Hard	8	18.60	6	13.95	14	32.56			
Role Demand							0.150	0.608	Insignificant
a) Easy	1	2.33	3	6.98	4	9.30			
b) Fair	17	39.53	17	39.53	34	79.07			
c) Hard	2	4.65	3	6.98	5	11.63			
Management Style							0.286	0.147	Insignificant
a) Easy	5	11.63	6	13.95	11	25.58			
b) Fair	14	32.56	11	25.58	25	58.14			
c) Hard	1	2.33	6	13.95	7	16.28			
Career Issues							0.224	0.323	Insignificant
a) Easy	3	6.98	5	11.63	8	18.60			
b) Fair	14	32.56	11	25.58	25	58.14			
c) Hard	3	6.98	7	16.28	10	23.26			
Interpersonal Relationship							0.405	0.015	Significant
a) Easy	3	6.98	0	0.00	3	6.98			
b) Fair	12	27.91	22	51.16	34	79.07			
c) Hard	5	11.63	1	2.33	6	13.95			
Environment Condition Factors							0.214	0.356	Insignificant
a) Easy	4	9.30	5	11.63	9	20.93			
b) Fair	14	32.56	12	27.91	26	60.47			
c) Hard	2	4.65	6	13.95	8	18.60			

3.3 Correlation Work Factors (Leadership and Supervision, Engineering, Purchasing, Maintenance, Work Standard, Excessive Wear, Tear Tool and Equipment, Abuse or Misuse) with Workers' Unsafe Acts.

Table 3.3 depicted responden appraisal about work factor. Leadership and Supervision aspects indicators which had good score was correlated with unsafe acts on 14 workers (32.56%). Engineering aspect which had poor score was correlated with unsafe acts on 19 workers (44.19%). Furthermore, Purchasing aspect which had poor score was correlated with unsafe acts on 18 workers (41.86%). Lastly, maintenance aspect which had good score was correlated with unsafe acts on 15 workers (34.88%).Tool and equipment aspect which had poor score was correlated with unsafe acts on 15 workers (34.88%), while work factor with indicator of work standard aspect which had poor score was correlated with unsafe acts on 12 workers (27.91 %). Furthermore, work factor with indicator of excessive wear and tear aspect which had poor score was correlated with unsafe acts on 15 workers (34.88%). Lastly, abuse or misuse aspect which had good score was correlated with unsafe acts on 17 workers (39.53%).

Table.3.3: Correlation Work Factors with Workers' Unsafe Acts

Independent Variables: Work Factors	Dependent Variables: Workers' unsafe behavior				Total		Association Coefficient	Score Sign. (2-tailed)	Conclusion
	Safe		Unsafe						
	N	%	N	%	N	%			
Work Factors									
Leadership and Supervision							0.316	0.029	Significant
a) Good	18	41.86	14	32.56	32	74.42			
b) Poor	2	4.65	9	20.93	11	25.58			
Engineering							0.287	0.049	Significant
a) Good	9	20.93	4	9,30	13	30.23			
b) Poor	11	25.58	19	44.19	23	53.49			
Purchasing							0.401	0.004	Significant
a) Good	13	30.23	5	11.63	18	41.86			
b) Poor	7	16.28	18	41.86	25	58.14			
Maintenance							0.281	0.055	Insignificant
a) Good	18	41.86	15	34.88	33	76.74			
b) Poor	2	4.65	8	18.60	10	23.26			
Tool and Equipment							0.245	0.098	Insignificant
a) Good	12	27.91	8	18.60	20	46.51			
b) Poor	8	18.60	15	34.88	23	53.49			
Work standard							0.410	0.003	Significant
a) Good	18	41.86	11	25.58	29	67.44			
b) Poor	2	4.65	12	27.91	24	55.81			
Excessive Wear and tear							0.528	0.00	Significant
a) Good	19	44.19	1	2.33	20	46.51			
b) Poor	8	18.60	15	34.88	23	53.49			
Abuse and Misuse							0.352	0.014	Signifikan
a) Good	20	46.51	17	39.53	37	86.05			
b) Poor	0	0.00	6	13.95	6	13.95			

3.4 Correlation all Independent Variables with Unsafe Acts

All sub independent variables were performed candidate selection utilizing analysis of logistic regression (P-value < 0.25). Next, all sub independent variables were counted by using analysis of binary logistic regression. The result of analysis binary logistic regression by Backward Stepwise (Wald) method on table 3.5 found that only variables of work factors with indicator of excessive wear and tear (1) had significant correlation with unsafe acts (P –value 0.001).

Table.3.4: The result of analysis binary logistic regression among variables of respondent's characteristics, work stressors, work factors with variable of unsafe acts.

No.	Independent Variables		Score Sign.
1	Respondent Characteristics	Age	0,099
		Personality type	0,191
2	Work Stressors	Content and control	0,216
3	Work Factors	*Leadership and supervision*	0,197

		Engineering	0,901
		Purchasing	0,766
		Maintenance	0,217
		Tool and Equipment	0,692
		Work Standards	0,135
		Excessive wear and tear (1)	0.001
4	Constant		0.040

IV. DISCUSSION

4.1 Correlation between factor of workers' characteristics (Age, Work Period, OHS and welding trainings, and personality type) and Workers' Unsafe Acts

Based on the data explained above, it was found that workers age 45– 54 years old proven to perform unsafe acts (37.21%). Also, experienced workers were proven to frequently perform unsafe acts (51.16%). The results were because experienced workers and older workers tended to take short cut. They felt safe and were used to performing such acts. In Incident Causation Model, Germain (2002) stated that underlying cause was due to inadequate control which triggered incompliance. Aksorn (2007) reported that there is correlation between workers' characteristics (age, working experience) with unsafe acts. Workers with Neuroticism personality tended to perform unsafe acts. Neuroticism characteristic is emotional. Involvement on OHS or welding training was proven not related to unsafe acts. It was because post training assessment at workplace has not been done. Hence, welders could not be classified as skilled welders.

4.2 Correlation between work stressors (work load, content and control, role demand, management style, career issues, interpersonal relationship, and environment condition factors) and unsafe acts

Work stress defines as harmful emotional and physical response which occurs when work requirements do not meet capability, resource, and workers' needs. **Work load**, this factor insignificantly caused unsafe acts. It was because there were up to 3 work shifts to handle transportation increasing orders. Also, there were countless contract workers and interns (± 700 workers) caused work load divided evenly. **Content and control,** performing constant welding could be work stressor. However, this task was conducted together and based on schedules. This factor insignificantly caused unsafe acts. **Role Demand**, this factor was not included into hard stressor because workers had association called SPSI which could distribute and solve several problems. Besides, there was clear job description. **Management style,** this study found that even though management commitment was not optimal; yet, workers could accept work conditions because their basic needs were compromised, such as: basic salary, overtime compensation, and other facilities. Therefore, this factor was hardly included in work stressor and had no significant correlation with unsafe acts. **Career Issue**, the workers could accept that they would hardly be promoted. They realized that their education qualification of High School diploma was low. Therefore, it did not cause significant stressor. **Environment condition factor** was in normal level. Even though, some was below normal such as: lighting for highly precision job was below normal level only in 45 lux (the normal level is 200 lux). This condition, however, was not considered as stressor because they were used to working in such condition.

Interpersonal relationship was found as the most significant work stressor which caused unsafe acts. Lack of contacts among workers and management and lack of welders' involvement in making decisions related to production or OHS could lead to tension, such as: disrespect, dissatisfaction, mental and physical health problem as body response (immunology or endocrine) towards stress. This tension might not be felt by the stressful workers. The same results were found in Melia dam Becerril in Kohsravi, 2014 which showed that lack of feedbacks, poor communication, poor relationship, and inadequate management supports contribute to the highest cause of work stress. The findings were also supported by J. Hurell theory which stated that cognitive stress related to poor decision making, disturbed concentration, disrupted memory, and confusion.

4.1 Correlation Work Factors (Leadership and Supervision aspects, Engineering, Purchasing, Maintenance, Work Standard, Excessive Wear and Tear, Tool and Equipment, Abuse or Misuse) with Unsafe Acts

One of factors which cause unsafe acts besides individual factor is work factors which reflected on organization work process, including: **Leadership** and **Supervision** were related to unsafe acts, the correlation was significant. The unsafe acts were due to lack of supervision and poor communication among workers, supervisors and management. **Engineering ,** every aspect

related to explanation assessment, building monitoring, Human resources factor, operational readiness and supervision in manufacturing products were correlated significantly with unsafe acts. Unsafe acts occurred because there was no socialization for workers regarding risk assessment by OHS staffs and, the supervision was not optimal. **Maintenance**, every task aimed at maintaining equipment including: testing, measuring, replacing, suiting, and repairing had no correlation with unsafe acts. It was due to regular equipment maintenance and update conducted by the management.**Purchasing,** every resource finding process, order, and purchasing products or service for manufacturing unit. This aspect had significant correlation with unsafe acts. The welders were not involved in purchasing because this aspect was responsibility of other unit. **Tool and Equipment,** every aspect related to need assessment, equipment provision, and tools replacement had no correlation with unsafe acts. Every need of welders was fulfilled by the management even though few of equipment was still inadequate, such as: PPE and fire extinguishers. **Work Standard**, a guide to explain every task and process. This aspect had significant correlation with unsafe acts. Work operational standard and instruction had been made by the company. However, there was lack of supervision and SOP socialization was not optimal. **Abuse** and **Misuse**, wrong way use of equipment or for wrong purpose had significant correlation with unsafe acts. It was supported by the fact of using expired fire extinguisher for fire emergency training. It was still installed at workshop wall and had not been replaced. Also, act of welding on left over worn out paint on iron still occurred. **Excessive Wear and Tear.** This aspect had significant correlation with unsafe acts.

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4.5. Correlation of all independent variables with Unsafe Acts

There was strong significant correlation between excessive wear and tear with unsafe acts. These were due to improper using planning, excessive use, expired tools utilization, and incompetent users. The results were based on facts below:

a. Equipment using planning in XYZ Ltd. was inadequate. Inadequacy of risk assessment caused many workers performed unsafe welding. Also, a lot of them did not use complete PPE. The unsafe acts occurred because there was no socialization of risk assessment results.
b. Utilizing expired equipment. Expired fire extinguishers were found in corner of room. Hazards could emerge in case of fire occurs. Act of using expired fire extinguishers was an unsafe act.
c. Inspection and monitoring were inadequate. Total of OHS staff was only 4 people (active). It was incomparable to total of workers which were more than 750 people. Ideal number is 1 supervisor monitors 50 workers.
d. Maintenance was inadequate. Replacement of broken welding spare parts even if partly could lead to unsafe acts.
e. Using equipment by incompetent workers. Interns, certain contract workers, and no post training assessment at workplace for definitive workers led to unsafe acts.

The management of transportation manufacturing company should create safety environment. Hence, safety behavior could be maintained. In addition, socialization of SOP should be encouraged for welders, support of the management in providing OHS facility for welders and adequate supervision of PPE use are necessary to create safe acts environment. Also, empower of personnel supervisor of each unit in the field as OHS supervisory personnel

V. CONCLUSION

Based on the results and discussion, it could be concluded that:

1. There was partial correlation among age, work period, personality type with workers' unsafe acts
2. There was partial correlation between interpersonal relationship and unsafe acts.
3. There was partial correlation among leadership and supervision aspects, engineering, purchasing, work standard, excessive wear and tear, abuse or misuse with workers' unsafe acts.
4. There was correlation among excessive wear and tear with workers' unsafe acts.

Limitation of Study. In this study, data of unsafe acts were collected based on workers' memories not direct observation on the site. Certificates of OHS and welding trainings had not been obtained completely. The total of workers in this study did not cover all welders, interns, and contract workers. The results of study could not depict the whole population. It is recommended for next study to enlarge samples of study.

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