Dominant Factors That Effecting The Working Position Change On Beverage Packing Enployment

Dominant Factors That Effecting The Working Position Change On Beverage Packing Enployment

Renny Septiari[1,2,*], Pratikto[1], Purnomo B. Santoso[1], and Ishardhita P. Tama[1]

[1]Mechanical Engineering Department, Faculty of Engineering, Brawijaya University, Malang, Indonesia
[2]Industrial Engineering, National Institute of Technology (ITN) Malang, Indonesia

*Email:rennyseptiari@gmail.com

Abstract. Work done by standing requires a lot of energy compared to sitting. Because the standing position is an alert attitude peformed by the body both physically and mentally, so that the work activities carried out are faster, stronger and more thorough. Prolonged health problems related to standing position are discomfort of lower extremities and fatigue, swelling of lower extremity, back pain and fatigue throughout the body. The purpose of this study is to determine the dominant factors and the influence of the variables tested on changes in working position and the fatigue level that occurs. The analysis results with the assist of the SmartPLS program show that the dominant factor of each influential variable was work shift variable, the dominant indicator was the time of morning shift packing speed, the workload variable was the heart rate, and the physical work environment variable was air condition. While the variables that most influence the level of fatigue was changes in working positions that have a positive and significant effect.

Keywords: working position, work shift, workload, physical environment, fatigue.

1. Introduction

Work carried out in a standing position as in the beverage packing section is a work that involves physical work that is quite tiring. In which the standing position is an alert attitude performed by the body both physically and mentally, so that the work activities are faster, stronger and more thorough. In the packing process, an operator performs his activities in a static position throughout the working time (Brown et al., 2003, Thorp et al., 2009). The working position that is performed by standing is suitable for work that requires a lot of sideways, downward, and upward movements (Hasegawa, et al., 2001). Some health problems related to standing position that are prolonged are discomfort of lower extremities and fatigue, swelling of lower extremities, back pain and fatigue throughout the body (Chester et al., 2002).

Static behavior at work indicates the risk of diseases such as obesity, diabetes, some cancers and deaths from various cases (Duncan and Mummery, 2005, Blanck et al., 2007, Hamilton et al., 2008,

Moradi et al., 2008, Katzmarzyk et al., 2009, Straker and Mathiassen, 2009, Ekblom et al., 2010, Van Uffelen et al., 2010, Owen et al., 2010, Healy et al., 2011, Reiff et al., 2012)

Glass beverage packing work is one of the jobs that are classified as repetitive and monotonous (Septiari et al., 2018), because the same activity is done more than once in the process of completing the product. Even though the workforce is not too much in doing this work, the workload felt by the workers feels bigger because the routine is completed every day and there is no variation in work. Static work attitudes over a long period of time lead to more complaints on the musculoskeletal system. Static and repetitive work can cause fatigue and boredom

Today many health and safety authorities recognize that the risk for neck and shoulder problems not only arises from work with a high physical burden, but also from low but repetitive energy output with low work variations (Straker and Mathiassen, 2009). As in the beverage packaging industry, many jobs are done by standing, sitting and monotonous along with repetitive work so it feels boring. The result of this boredom causes discomfort and fatigue in the work so that it can lead to decreased productivity. Discomfort in body position, high work repetition and great effort (Roman-Liu et al., 2004) are some of the things that can trigger fatigue (Traugakos, 2007).

To reduce the feeling of discomfort and fatigue due to monotonous and repetitive work therefore a combination of sitting and standing working positions are given. This is done so that the level of fatigue and discomfort can be eliminated. From this research,the dominant factors that influence the changes combination in working position in the packing process will be determined. It is expected that from these factors the reasons that cause discomfort from the work can be known which in turn can be reduced or eliminate, in order that work performance can be increased by the combination of changes in working position given.

2. Theoretical framework

2.1Workload

Workload is an effort that must be taken out by someone to fulfill the demand of the job. Workload is the size/portion of the limited operator capacity needed to do certain work. As for capacity here is the ability possessed by someone.

2.2Work Fatigue

Work fatigue according to Tarwaka (2004) is a protection mechanism to avoid further damage, so that recovery happens after rest. Work fatigue according to AM. SugengBudiono (2003) is a condition accompanied by a decrease in efficiency and needs in work

2.3 Physical work environment

Exposure to the physical environment is one aspect that can cause disruption to the work environment and can affect the conditions of each operator. With a comfortable work environment, it is expected to improve employee performance optimally and productively without any disruption and anxiety when performing packing activities.

2.4 Smart PLS

Partial Least Square (PLS) is a family-based regression method introduced by Herman O.A Wold for the creation and construction of models and methods for social sciences with predictive-oriented approaches. PLS has the assumption that free research data is distributed (Distribution Free), meaning that the research data does not refer to one particular distribution (e.g. normal distribution). PLS is an alternative method of Structural Equation Modeling (SEM) which can be used to overcome the problem of relationships among complex variables but the size of the data sample is small (30 to 100), given that SEM has a minimum data sample size of 100 (Hair et al, 2010).

3. Research Methodology

3.1 Variable identification

Tabel 1. The variables that affect the combination of changes in work position

Variable	Definition
Work shift	Work shift used in this study is morning and afternoon work shifts seen from the time of packing speed used. This is used to see the differences that arise between packing activities performed in the morning and evening.
Workload	Workload is measured from the average rate of heart rate that occurs during the packing process and the average oxygen consumption used.
Physical work environment	The measurement of the physical work environment uses a questionnaire consisting of 11 questions divided into 5 groups, namely Air Condition (X), Noise (Y), Vibration (Z), Lighting (V), and Spatial Planning (W). Assessment of the physical environment using a Likert scale with the assumption: 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = totally agree.
Work fatigue	For fatigue level measurement, use the Job Fatigue Feeling Questionnaire (KAUPK2) which will be given to each packing operator. Assessment of fatigue level uses a Likert scale with the following assumptions: 1 = No; 2 = Sometimes; 3 = Often; 4 = always As for the results of the fatigue level is the choice answer of each operator, the most selected of the 17 questions asked are divided into 4 groups, namely concentration (A), physical fatigue (B), anxiety (C), and working motivation (D).

From the variables used in table 1., the following hypothesis can be formulated:
H1: Work shift affects the work position
H2: Workload affects work position
H3: Physical environment influences work position
H4: Work position affects the fatigue level
Based on these hypotheses, the model or construct of this research is as shown in Figure 1.

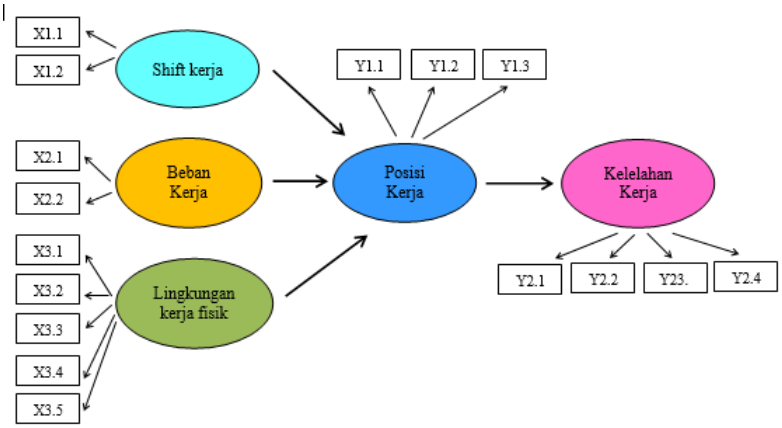

Figure 1. PLS Model Flow Chart

4. Indicator Determination

Based on the variables identification from table 1. Then the measuring indicator can be determined as in table 2.

Table 2. Independent Variables and Dependent Variables

Independent Variables	**Indicators**	
Work shift	X11	Time of morning shift packing speed
	X12	Time of day shift packing speed
Work load	X21	Average heart rate
	X22	Average oxygen consumption
Physical work environment	X31	Air condition
	X32	Noise
	X33	Vibration
	X34	Lighting
	X35	Spatial planning
Dependent Variables		**Indicators**
Work position	Y11	Sitting position only
	Y12	Stand up position only
	Y13	Seated and standing position alternately
Fatigue level	Y21	Concentration
	Y22	Physically tired
	Y23	Anxiety
	Y24	Work motivation

5. Results and Discussions

Table 3. Outer Loading

Indicator	Outer Loading
X11	0.918
X12	0.852
X21	0.959
X22	0.765
X31	0.935
X32	0.821
X33	0.854
X34	0.932
X35	0.814

From table 3. it can be explained that the most dominant indicator as a reflection of the work shift variable was the time indicator of the morning shift packing speed with the outer loading valueof 0.918 which means the indicator contribution to the variable latent value was 91.8%. For the variable workload indicator the most dominant was the heart rate with a value of 0.959, and the physical work environment with the most dominant factor was the air condition with a value of 0.935.

Table 4. Outer Weight

Indicators	Outer Weight
Y11	0.478
Y12	0.496
Y13	0.197
Y21	0.348
Y22	0.402
Y23	0.327
Y24	-0.072

From table 4. It can be explained that the data in the table shows that the outer weight value of all indicators has a positive value indicating the indicator positive contribution to the measurement of work position variables. While the fatigue level variable data shows that the outer weight value of all indicators has a positive value indicating the positive contribution of indicators on the measurement of the fatigue variable level, except for working motivation which indicates a negative contribution to the fatigue level which means working motivation does not affect the fatigue level.

Table 5. Test Results of Standing Position Direct Influence

	Path Coefficient	***P Value***	***Explanation***
Work shift → Work position (Y1)	0.914	0.361	Not significant
Workload → Work position (Y1)	1.699	0.090	Significant
Physical environment → Work position (Y1)	2.263	0.024	Significant
Work position → Fatigue level (Y2)	14.238	0.000	Significant

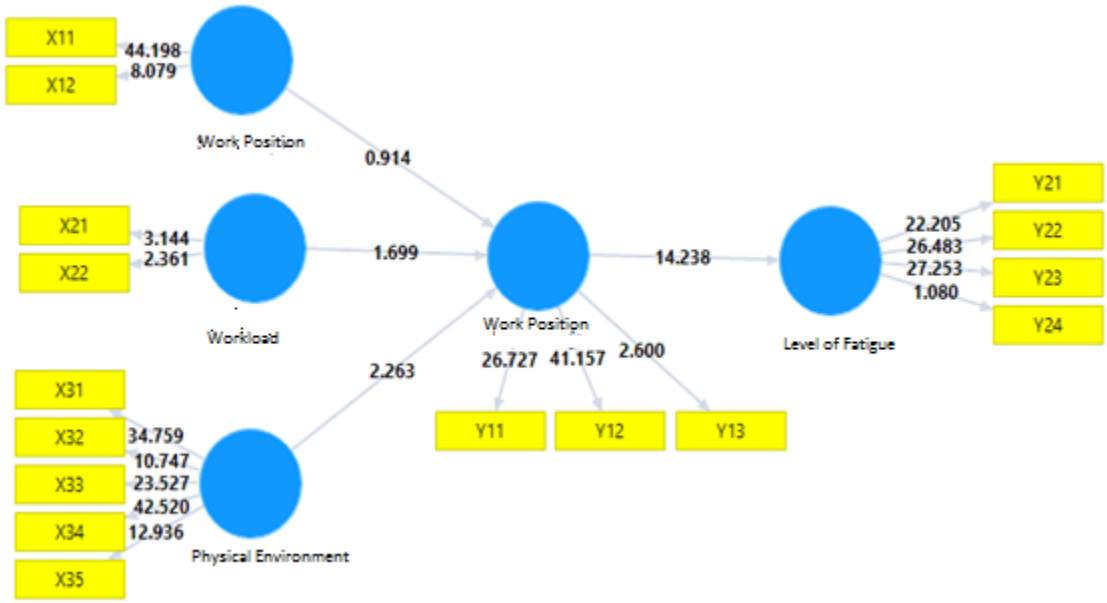

Figure 2 Path Diagaram of Standing Position Hypothesis Test Results

The direct effect of work shift on working position was positive and not significant with the path coefficient magnitude of 0.914 and p value of more than 0.1. The direct effect of workload on work position was positive and significant with the path coefficient magnitude of 1.699 and p value of less than 0.1. The direct effect of the physical environment was positive and significant with the path coefficient amount of 2.263 and p value of less than 0.1. The direct effect of work position on the fatigue level was positive and significant with the path coefficient amount of 14.238 and p value of less than 0.1. As shown in Figure 2.

6. Conclusions

In the working position performed by standing, dominant factors that influence the physical work environment which has a positive and significant effect with path coefficient value is higher than the workload which is equally positive and significant. The physical work environment of a workplace is very influential on one's performance because if the existing work atmosphere does not support, then the expected comfort is impossible to obtain in working, causing someone to work in a state of

anxiety and insecurity. This is what causes work performance to decrease in order that the output obtained is not optimal.

7. References

[1] Blanck, H.M., et al., 2007. *Sedentary Behavior, Recreational Physical Activity, And 7-Year Weight Gain Among Postmenopausal U.S. Women.* Obesity (Silver Spring) Juni **15**(6):1578-88.

[2] Brown, W.J., Miller, Y.D., Miller, R., 2003. *Sitting Time and Work Patterns as Indicator of Overweight and Obesity in Australian Adults.* Int. J. Obes. Relat. Metab. Disord. **27**1340-1346.

[3] Bureau of Labor Statistic, 2009, Jun 24. News. US. Departement of Labor.

[4] Chester Mandy, Rys Malgorzata, Konz Stephen, 2002. *Leg Swelling, Comfort and Fatigue When Sitting, Standing, and Sit/Standing.* International Journal of Industrial Ergonomics.**29**289-296.

[5]Chau Josephine, Daley Michelle, Srinivasan Anu, Dunn Scott, Bauman Adrian, Ploeg Hidde, 2014. *Desk Based workers perspectives on using sit-stand workstations : a qualitative analysis of the stand @ work study.* BMC Public Health 14.752.

[6] Christensen Hanne, Sogaard karen, Pilegaard Marianne, Olsen Henrik, 2000. *The Importance of The Work/Rest Pattern as a Risk factor in Repetitive Monotonous Work.* International Journal of Industrial Ergonomics. **25**367-373.

[7] Duncan, M and Mummery, K., 2005. *Psychosocial and environmental factors associated with physical activity among city dwellers in regional Queensland.* Preventive Medicine April **40**(4):363-72.

[8] Enoka, R.M., Stuart, D.G., 1992. *Neubiorology of Muscle Fatigue.* J Appl Physiol **72**1631.

[9] Fenety, A., Walker, J.M., 2002. *Short-term Effects of Workstation Exercise on Musculoskeletal Discomfort and Postural Changes in Seated Video Display Unit Workers.* Phys. Ther. **82** (6) 578-589.

[10] Gilad Issachar, 1995. *A Methodology for Functional Ergonomic in Repetitive Work.* International Journal of Industrial Ergonomic.**15**91-101.

[11] Hamilton, M.T., Healy, G.N., Dunstan, D.W., Zderic, T.W., and Owen, N. 2008. *Too little exercise and too much sitting: inactivity physiology and the need for new recommendations on sedentary behavior.* Curr. Cardiovasc. Risk Rep. **2**(4) 292–298.

[12] Hasegawa Tetsuya, Inoue Koki, Tsutsue Osamu, Kumashiro Masaharu, 2001. *Effects of a Sit-Stand Schedule On a Light Repetitive Task.* International Journal of Industrial Ergonomics.**28**219-224.

[13] Healy, G.N., Matthews, C.E., Dunstan, D.W., et al., 2011. *Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06.* European Heart Journal March **32**(5)590-7.

[14] Karakolis Thomas and Callaghan Jack, 2014. *The Impact of Sit-Stand Office Workstations on Worker Discomfort and Productivity : A Review.* Applied Ergonomics.**45**799-806.

[15] Katzmarzyk, P.T., et al., 2009. *Sitting Time And Mortality From All Causes, Cardiovascular Disease, And Cancer.* Medicine and Science in Sports and Exercise May.**41**(5) 998-1005.

[16] Reiff, C., et al., 2012. *Difference in caloric expenditure in sitting versus standing desks.* Journal of Physical Activity and Health September.**9**(7) 1009 11.

[17] Roman-Liu, et al., 2004. *Quantitative Assessment Of Upper Limb Muscle Fatigue Depending On The Conditions Of Repetitive Task Load.* Journal of Electromyography and Kinesiology December.**14**(6) 671-82.

[18] Septiari,R., Pratikto, Santoso, Purnomo., Tama, Ishardita., 2018. *The Influence of Combining Sitting and Standing Position in Plastic Glass Packaging.* Journal of Engineering Science and Technology. **13** (2) 373-380.

[19] Straker Leon, and Mathiassen Svend Erik, 2009. *Increased physical work loads in modern work--a necessity for better health and performance?.* Ergonomics October. **52**(10) 1215-25.