GROSTLOG 2018
Global Research on Sustainable Transport & Logistics

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

The Effect of Human Factors and Warehouse System on Order Picking Process

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Abstract

Order Picking process has an important role in warehouse operation. Following the development of technology and the increasing demand of customer's wants, warehouse operation system continously improves. The purpose of this reasearch is to identify the influence of manual handling operated by human and warehouse system on order picking process performance, and the relations among them. This paper is using multiple linear regression analysis. A questionnaire was used to collect data from samples and regressionan analysis was used. The result shows that each human factor and warehouse system has the positive impact to order picking performance of 72.7% and the rest are affected by other factors.

Keywords: warehouse system, order picking process, human factor

Introduction

In this globalization era the competition in logistics is tighter. Companies need to get products out quickly, full-service, high-quality, low-cost and customer's satifaction in logistics system (Kusrini, Novendri, & Helia, 2018). Due to the complexity of logistic network, warehousing is one of logistics component that has the important key in logistics system. Regarding the tight competition, to create the sustainability of logistics companies are encouraged to optimize the warehouse management especially in efficiency and productivity.

One of the most important warehousing processes in terms of time and cost is Order Picking (OP). Order picking involves the process of grouping and scheduling the customer's orders, setting location of the stock according to order lines, removing orders to the floor, picking and carrying the goods from storage locations and the disposal of the picked goods (Koster, Le-duc, & Roodbergen, 2007). Order picking process spent accounts more than 50% of the total warehouse operating expenses (Horvat, 2012). Order Picking Process is the most intensive

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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activity for employing human in warehouses with manual systems, and spend the most capital operation in warehouses with automated systems (Koster et al., 2007)

Although warehousing uses an automated system with advanced technology in recent years, most companies still rely on the order picking process manually, which is by relying on human resources. More than 80% of the order picking process in the warehouse is done manually, because humans are considered more flexible than machines, especially when the need for logical reasoning that cannot be done by the machine (Koster et al., 2007). The escalation of industrial differentiation, also being the cause of manual systems more flexible than automated system, because products are heterogeneous and changing continuously (Grosse, Glock, & Neumann, 2017).

On the other side, using manual system sometimes has the disadvantages. By using manual system the order picking performane is very dependant on the cognition of employees, sometimes it cause the error on counting and identifying items (Ae, Seok, Shim, & Cho, 2015). In this case, people create the improvement and find the innovation to optimize the order picking performance. Since the technology improves and develops rapidly, the automated system of warehousing is used which is called Warehouse Management System (WMS). The automated warehouse system is still developing in Indoneisa. Automated warehouse system is expected to reduce the cost through the effective and productive warehouse process (Atieh et al., 2016). The decision support prioritizing task of planning and controlling the order picking processes within a WMS, and WMS supplier are prospecting to increase the productivity and optimize the order picking operation by integrated system (Moeller, 2011).

The manual handling and using warehouse system coud be affected to order picking performance (Ae et al., 2015). The human factor that affects to the employee performance are perceptual, mental, physical, and phsycosocial (Grosse, Glock, Jaber, & Neumann, 2015; Grosse et al., 2017; Grosse, Glock, & Neumann, 2015). The warehouse system in general already uses a computerization system which impacts the performance of order picking process so the performance of

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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order picking process could be measure in productivity, time, and quality (Staudt et al., 2015). In this study, the authors take the human factor and warehouse system as the independent variables. Choosing the right system in warehouse with different characteristics is important to optimize the efficiency and productivity. This paper presents whether the optimization of order picking performance are affected by human factor and automated system from several logistics companies operating in Jakarta, collected by 100 respondents.

Method

This paper use the quantitative data collected from samples who are operators in several warehouses with different characteristics. The source of primary data is collected directly by answering the quetionnaire given to the operational warehouse staff and supervisor. Besides the primary data the authors also use the secondary data obtained from various sources such as journals and books related to the material discussed. The population of data is the employees in third party logistics company within warehouse operations or material handling division and also the supervisor of warehouse operation and warehouse manager. Data analysis technique in this paper is multiple linear regression which measures linear relationship between two or more variables. Independent variable for X_1 is Human Factor and variable X_2 is Warehouse System then variable Y is Order Picking Process Performance. The discussion and result part will describe the result of this study that consist of 100 respondents. The result briefly describes the influence of each independent variable to dependent variable and also the impact of independent variable simultaneously to dependent variable.

The hypothesis of this study is as follows.

H_1 Human factor (X_1) significantly affects order picking process (Y)

H_2 Warehouse System (X_2) significantly affect order picking process performance (Y)

H_3 Human factor (X_1) and Warehouse Systems (X_2) simultaneously affect order picking process

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Discussion and Result

According to the survey and interview the supervisor of warehouse operations of logistic companies, most warehouses in Indonesia rely on manual handling. Picking the goods from storage on the warehouse still use forklift operated by human. The human factor determines the accuracy of picking the goods. Collecting the goods in accordance to customer's request is very simple by manual handling but it takes time to search and travel the warehouse aisle to find the correct goods. This study analyzea the influence of manual handling which means the human factor that becomes the most consideration of order picking process performance. However, during the development of technology some of warehouses already use warehouse management system which means they use computerization to input data. The goods received are inputted manually to the computer system. Then the result appear to be matched to the actual physic goods and automatically a barcode is printed. Either raw material or finished goods already use barcode. The picker is easier to find the goods as requested accurately on storage than searching the goods manually without barcode.

The typical warehouse system on order picking adopted in some warehouses in Indonesia is only barcoding. Using barcode improves the acuracy of picking the goods from storage. The information given from system is more detail and easy to understand. But it does not give positive impact to the speed of order picking process. Raw material using automated system takes longer time because it needs to input the received goods to the computer first manually and re-check to the actual goods. On order Picking Process there are some factor that can influence the performance of order picking. Manual handling means employing human could impact to the productivity. The data result and explanation obtained from questionnaire is described below.

Table 1. Respondents Profile

No	Demographic	Information	N	Percentage
1	Gendre	Male	88	88 %
		Female	12	12 %
2	Age	17^{th}-$24t^{h}$ Years	39	39 %
		25^{th} -34^{th} Years	39	39 %
		35^{th} -49^{th} Years	21	21%

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/atlr

		50^{th} -64^{th} Years	1	1 %
3	Education	High School	76	76 %
		Diploma Degree	6	6 %
		Bachelor's Degree	18	18 %
4	Employment Status	Regular Employee	42	42 %
		Contract Employee	58	58 %
5	Length of Work	1^{st}-2^{nd} Years	36	36 %
		2^{nd} -3^{rd} Years	13	13 %
		3^{rd}-4^{th} Years	5	5 %
		> 4^{th} Years	46	46 %

Source : Author

Based on the table above, it can concluded that the average respndents of warehouse emloyee in several logistics companies is male (88%) with the majority of age ranges is from 17^{th}-34^{th} Years old. The most of respondents are high school graduates (76%) with the average of employment status as a contract Employee (58%) and most of them have worked for more than 4^{th} working years (46%).

Data Analysis

The first analysis is to test the validity. This Validity test aims to determine the validity of questionnaire of collecting data. The basis for decision making in validity testing are : If the Pearson Correlative Value is greater than 0.195 then the Valid item is declared and if the Pearson Correlative Value is smaller than 0.195 then the Valid item is declared. Validity Test is with Bivariete Pearson Correlative Formula.

Tabel 2. Variable Validity Test Result

Item	Corrected Item – Tottal Correction	R Table	Criteria
1	.475	0.195	Valid
2	.491	0.195	Valid
3	.587	0.195	Valid
4	.639	0.195	Valid
5	.507	0.195	Valid
6	.653	0.195	Valid
7	.672	0.195	Valid
8	.648	0.195	Valid
9	.598	0.195	Valid
10	.610	0.195	Valid

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Advances in Transportation and Logistics Research
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11	.529	0.195	Valid
12	.530	0.195	Valid
13	.631	0.195	Valid
14	.657	0.195	Valid
15	.713	0.195	Valid
16	.268	0.195	Valid
17	.557	0.195	Valid
18	.641	0.195	Valid
19	.610	0.195	Valid
20	.651	0.195	Valid
21	.698	0.195	Valid
22	.603	0.195	Valid
23	.527	0.195	Valid
24	.664	0.195	Valid
25	.722	0.195	Valid
26	.679	0.195	Valid
27	.587	0.195	Valid
28	.573	0.195	Valid
29	.655	0.195	Valid
30	.532	0.195	Valid
31	.739	0.195	Valid
32	.724	0.195	Valid
33	.648	0.195	Valid
34	.661	0.195	Valid
35	.605	0.195	Valid
36	.514	0.195	Valid
37	.718	0.195	Valid
38	.621	0.195	Valid
39	.676	0.195	Valid
40	.646	0.195	Valid
41	.719	0.195	Valid
42	.687	0.195	Valid

Source : Author

Pearson Correlation Values are greater than 0.195 and 5% significance. Therefore it can be concluded that all item in this research questionnaire are valid, so that all item can be used as research instrument.

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Advances in Transportation and Logistics Research
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Reliability Test

Internal Consistency test (Realibility test) is done by calculating alpha coefficient from each instruments in one variable. The instrument used in variable is reliable if it has cronbach alpha coefficient more than 0.70. The result of reliability test is shown at table 4.

Tabel 3. Reliability Test

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.961	.962	42

Source : Author

The result of reliability test obtained the value of cronbach's alpha of all indicator is greater than the alpha value (0.961>0.70). Therefore, it can be conclude that all questionnaires in this study are reliable or consistent, it can be used as the research instrument.

Normality Test

The purpose of normality test to verify test whether in the regression model, the residual variable has a normal distribution. The normality test of this research shown at table 5.

Table 4. Normality Test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Human factors	.069	100	.200*	.982	100	.189

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Source : Author

According to the normality test with Shapiro-Wilk Test, the value of Asymp.sig is 0.189 greater than 0.05, so it can be concluded that the natural data of this research are normally distributed.

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Advances in Transportation and Logistics Research
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The first analysis will conduct the Linear Regression Analysis on variable Human Factor (X_1) to Order Picking Performance (Y).

Linear Regression Analysis

According to reseach analysis show that the influence of variable X_1 Human Factor toward Y Order Picking result shown at table 6.

Table 5. Regression Coefficient

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.905	3.194		1.223	.224
	Human factors	.429	.034	.789	12.722	.000

Source : Author

Regression test

According to coefficients output above, noted that coefficients regression value of human factor is 0.429. it means human factors has the positive effect to order picking process performance. The formula of regression test is Y=3.905 + 0.429 X_1. Then that positive effect can be stated that the increasing of human factor also arise the increasing of order picking process performance.

t test

The basis measurement for partial t test in regression analysis is if the t value greater than t table then independent variable effected to dependent variable. And also if the t value greater than t table then independent variable has no effect on dependent variable. According to the significance value of our research that shown at Table 6, the result shows if significance value smaller than 0.05 it means independent variable has the significant effect to the dependent variable. And if significant value greater than 0.05 the independent variable has effected to dependent variable.

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
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According to the regression analysis result obtained t value 12.722 greater than t table 0.1966 and significant value (Sig.) 0.000 smaller than 0.05. It can be conclude that H_o rejected and H_1 retained that means human factor significantly affects order picking process performance.

Table 7 that shown bellow consist of the result of our research on the effect of warehouse system (X_2) to order picking process (Y).

Table 6. Regression Coefficient

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.304	2.721		3.419	.001
	Warehouse system	1.062	.082	.795	12.962	.000

Source : Author

Regression test

Based on Coefficients output above, noted that the coefficients value of variable warehouse system (X_2) is 1.062 means positive. So, it can be stated that the Warehouse System (X_2) has positive influence to Order Picking process performance (Y). The formula of regression test result is $Y = 9.304 + 1.062\ X_2$.

t test

Based on regression analysis result shown at table 7 it obtained t value 12.962 greater than t table 0.1966 and significant value (Sig.) 0.000 smaller than 0.05. so we can conclude that H_o is rejected and H_2 retained. It means Warehouse System significantly affects Order Picking Performance.

Multiple Linear Regression Analysis

The Table 8 that shown bellow is analysis of the Multiple Linear Regression of variable Human Factor (X_1) and Warehouse System (X_2) to Order Picking Performance (Y).

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Table 7. Multiple Linear Regression

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	.670	2.782		.241	.810
	Human factors	.244	.042	.449	5.826	.000
	Warehouse system	.627	.103	.469	6.087	.000

Source : Author

Based on Table 8, there are three kinds of interpretation multiple linear regression. First is constanta (a) equals to 0.670 states that if variable X1 and variable X2 remain there will be consistency value of variable Y equals 0.670. then second interpretation is Human Factor (B1) equals to 0.244 states that if variable X1 increase, then variable Y will be increase by 0.244, assuming there is no addition or constant of variable X2. The third interpretation is Warehouse System (B2) equals to 0.627 states that if X_2 increase, then variable Y will be increase by 0.627, assuming there is no addition or constant value of X1. The result formula of multiple linear regression analysis is $Y = 0.670 + 0.244\ X_1 + 0.627\ X_2$.

R^2 (determinant coefficient)

Table 8. Model Summary

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.853[a]	.727	.721	3.101	1.660

Source : Author

According to table 8 we can analyze that determinant coefficient (R^2) is 0.727 or 72.7%. It shows that the percentage contribution of the impact of independent variables or Human Factor (X_1) and Warehouse System (X_2) on dependent variable Order Picking Process (Y) is 72.7% whereas the rest is 27.3% affected or explaned by another variable that not include in this research.

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F Simultaneous test

Table 9. ANOVA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2484.965	2	1242.482	129.211	.000[b]
	Residual	932.745	97	9.616		
	Total	3417.710	99			

Source : Author

According to the table the F value is 129.211 and F table is 3.09. The criteria of the test is if F value smaller than F table H_o is retained and if F is value more than F table then H_o rejected. The result shows that F value > F table (129.21>3.09) and the significance value is 0,000. Because of the significant value (Sig.) 0.000 <0.05 H_o is rejected, it means there is the significant effect between Human Factor and Warehouse System simultaneously on Order Picking process performance.

Conclusion

Order picking process is the most labour intensive process between other warehouse activities. Based on the results of research conducted by questionnaire dissemination techniques with a discussion of human factor and warehouse system to order picking process performance in several warehouse logistics companies, it can be concluded that :

There is a positive and significant influence between human factors on order picking process performance in several warehouse logistics companies in Indonesia, as indicated by r_{x1y} of 0.789 and r^2 of 0.623, which means that this variable affect the order picking process performance as much as 62.3% and the Value of t_{counts} is greater than t_{table} at the 5% Significance level of 12.722 > 0,1966, with N = 100. Regression line equation is Y = 3.905 + 0.429 X_1. And also there is a positive and significant influence between warehouse system on order picking process performance, as indicated by r_{x2y} of 0.795 and r^2 of 0.632, which means that this variable affect the order picking process performance as much as 63.2% and the Value of t_{counts} is greater than t_{table} at the 5% Significance level of 12.962 >

ISSN: 2622-5778 (online)
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0,1966, with N = 100. Regression line equation is Y = 9.304 + 1.062 $X_{2.}$ Between these two variable, the warehouse system has a slightly larger influence compare to the human factors.

The same goes between human factors and warehouse system also have a positive and significant influence on order picking process performance, which is indicated R^2 of 0.727, which means that this variable 72.7 % affect simultaneous the order picking process performance, $F_{count} > F_{Table}$ at a 5% significance level of 129.21 > 0,1966, with N = 100. Regression line equation is Y = 0.670 + 0.244 X_1+ 0.627 $X_{2.}$

Besides, it can also be said that workers at the warehouse are productive and do not require employee'status. Further researchers on this topic should include other variables because there are other possible variables that have more significant influence on order picking process performance. Furthermore, In Subsequent work it can research about the effect of other warehouse activities by measuring the service the level of service quality, customer satisfaction, work time, costs, work motivation and other factors. Or the researcher can also limit the warehouse system on focusing one system such as Radio Frequency Identification (RFID), Warehouse Management System (WMS), Light Picking Technology (PbL) and other systems.

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