Simulation of In Bag Fertilizer Loading Process In Port of Petrokimia Gresik to Increase Loading Rate

Bagusranu Wahyudi Putra and I Nyoman Pujawan
Department of Technology Management, Institut Teknologi Sepuluh Nopember, Surabaya
e-mail: bagusranuwahyudi@gmail.com

***Abstract*— Pelabuhan Petrokimia Gresik is one of the element to support the goverment regarding to maintain stability of fertilizer loading speed. The issue that occurs at Pelabuhan Petrokimia Gresik is the low speed of loading of fertilizer in the bag for the past 4 years. The low speed of loading fertilizer in bag tends to affect its cost. This study aims to simulate the process of loading fertilizer in bag at the Port of Petrokimia Gresik in order to find out the factors which influence the speed deterioration of fertilizer bagging process and applicable alternative scenarios to improve the process of loading fertilizer in bag. Simulations were executed using discrete simulation methods. The results show that loading speed downturn are influenced by significant factors as follows: high loading preparation time at the dock, which consumes 29,35% of loading activity; the high loading time at the dock, which reaches 23,15% of loading activity; also the extensive duration of truck commute from the warehouse to the pier which utilizes 22,95% of loading activity. This study evaluate 7 alternative improvement scenarios. According to ROI perspective, it is preeminent to additionally put field internal control personnel at each shift when loading fertilizer in bag, which can increase the loading speed to 668,29 tons / day, of investment (ROI) of 68% will be obtained within 1 year and the payback period will approximately result in 0,60 years. The best scenario in terms of loading speed is to add internal control personnel and apply a new method of loading fertilizer using a sling bag with an increase in loading rate to 804.17 tons / day, following ROI value of 23% within one year and a PP value of 0.81 year.**

***Keywords*—rate of loading fertilizer in bag, simulation, tariff of loading fertilizer in bag.**

I. INTRODUCTION

PT PETROKIMIA GRESIK is the most complete fertilizer manufacturer in Indonesia which produces various kinds of fertilizers and chemicals for agro-industry solutions [1]. The company with the Kebomas logo, located in Gresik Regency, East Java, Indonesia, is a subsidiary of PT. Pupuk Indonesia (Persero). PT Petrokimia Gresik is committed to expand and develop inevitably with the community, in order to support the realization of the National Food Security program, and the progress of the agricultural world. Fertilizers in Gresik Petrochemicals are distributed through land and sea to always be able to provide services and maintain the availability of fertilizer stocks to avoid fertilizer scarcity. In maintaining the scarcity of fertilizer, especially in areas outside Java, such as Kalimantan, Sumatra, Sulawesi, the sea transportation route has a high enough contribution to achieve this goal.

Gresik Petrochemical Port, located in Tlogopojok Village, Gresik District, Gresik Regency is a cargo muti port with 2 main activities, namely discharge and loading. Facilities and equipment to support these activities include docks, continuous ship unloaders, kangoroo cranes, marine loading arms, and operators. The types of goods served at Gresik Petrochemical Port are divided into 3 big groups, namely bulk goods, in-bag goods, and liquid goods. In the loading activity of in-bag goods there are several cargoes that are served at Gresik Petrochemical Port such as Urea Fertilizer, Phonska Fertilizer, Petroganik Fertilizer, SP-36 Fertilizer, Fertilizer ZA.

The status of Petrokimia Gresik Port is a special port or can be called TUKS (Private Interest Terminal) which only serves its own needs in loading and unloading operational activities. Loading activities are activities that are controlled directly by the Petrokimia Gresik Port and must be controlled effectively in order to get good performance. One of the parameters of good performance at PT Petrokimia Gresik is the time recorded when the ship docked at the dock. The length of a ship that is anchored at the dock is influenced by the speed of loading of fertilizer. The longer the fertilizer loadingspeed, the longer the ship will dock. This of course affects the cost of loading fertilizers, especially in bag fertilizers that require the assistance of third party services. The effect of loading speed and loading costs has been agreed with the contract that has been made by Petrokimia Gresik to third parties providing fertilizer bag loading services. The third party that has a direct influence on costs and loading speed is the loading service partner, in which case the partner is tasked with providing labor (labor) at the port during the in-process fertilizer loading process.

As explained earlier, performance and performance in loading services at the Gresik Petrochemical Port are measured by loading speed which affects the loading costs. If you see figure 1, there was an increase in the cost of loading fertilizer in bag in 2016 to 2019 at the Petrochemical Port of Gresik. The cost of loading in bags in 2019 can reach Rp.41,285 / ton, up from the cost in 2018. Costs incurred in the loading activity are loading services by third parties.

The increase in loading costs was due to the low speed of loading of in-bag fertilizers which could not reach the KPI (Key Performance Indicator) target of 600 tons / day. It can be seen in Figure 2 that the loading rate or speed of loading in the last 4 years from 2016 to 2019 has never reached the target set.

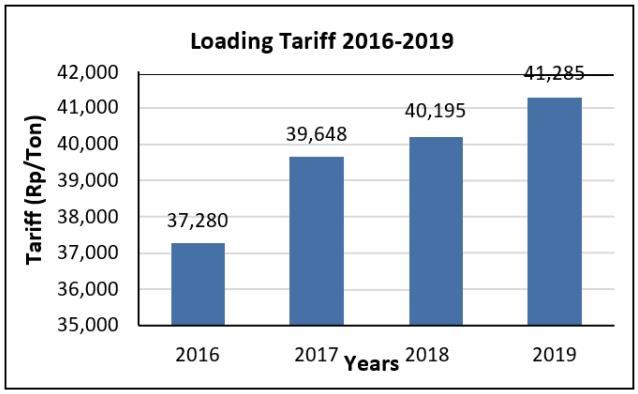

Figure 1. Loading Tariff 2016-2019

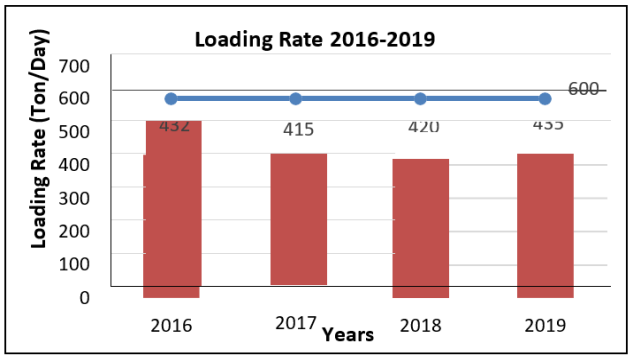

Figure 2. Loading Rate 2016-2019

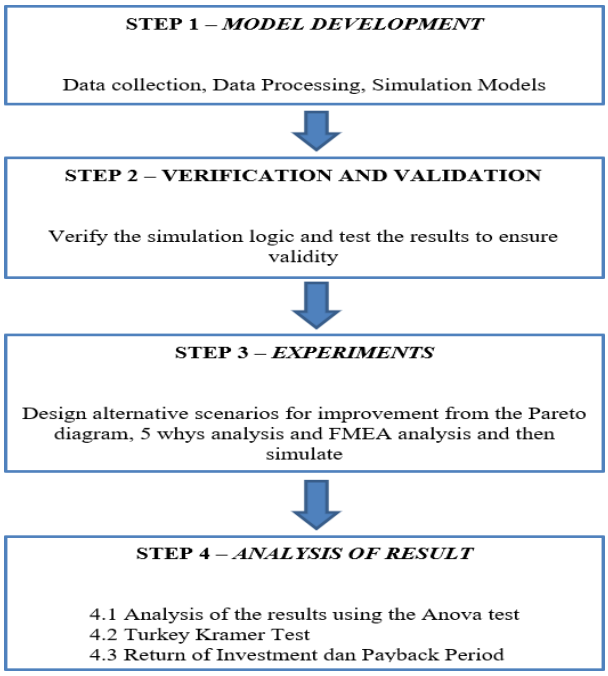

Figure 3. Research Steps

The company identifies factors that influence the slow processing time of in bag fertilizer loading, including the number of available flat trucks operated, the method of loading method that is less than optimal, and the factors of the high waiting time or preparation. From Figure 2 the company needs efforts to increase the loading rate. However, a comprehensive investigation is required to determine what strategies can be implemented to increase the loading rate effectively. This requires a number of improvement scenarios and each of these scenarios needs to be compared so that the best can be chosen. In order to make comparisons between improvement scenarios, a simulation method is needed, because the system is complex and has many uncertainties.

The utilization of simulation methods in port operations is critical in order to identify the real system that is happening. Decision making process is \ supported simulation methods in order to estimate phenomena that occur in the future, as well as changes that occur in the system if improvement efforts are made. Research that has encompassed simulation methods with the purpose of identifying the capacity of the

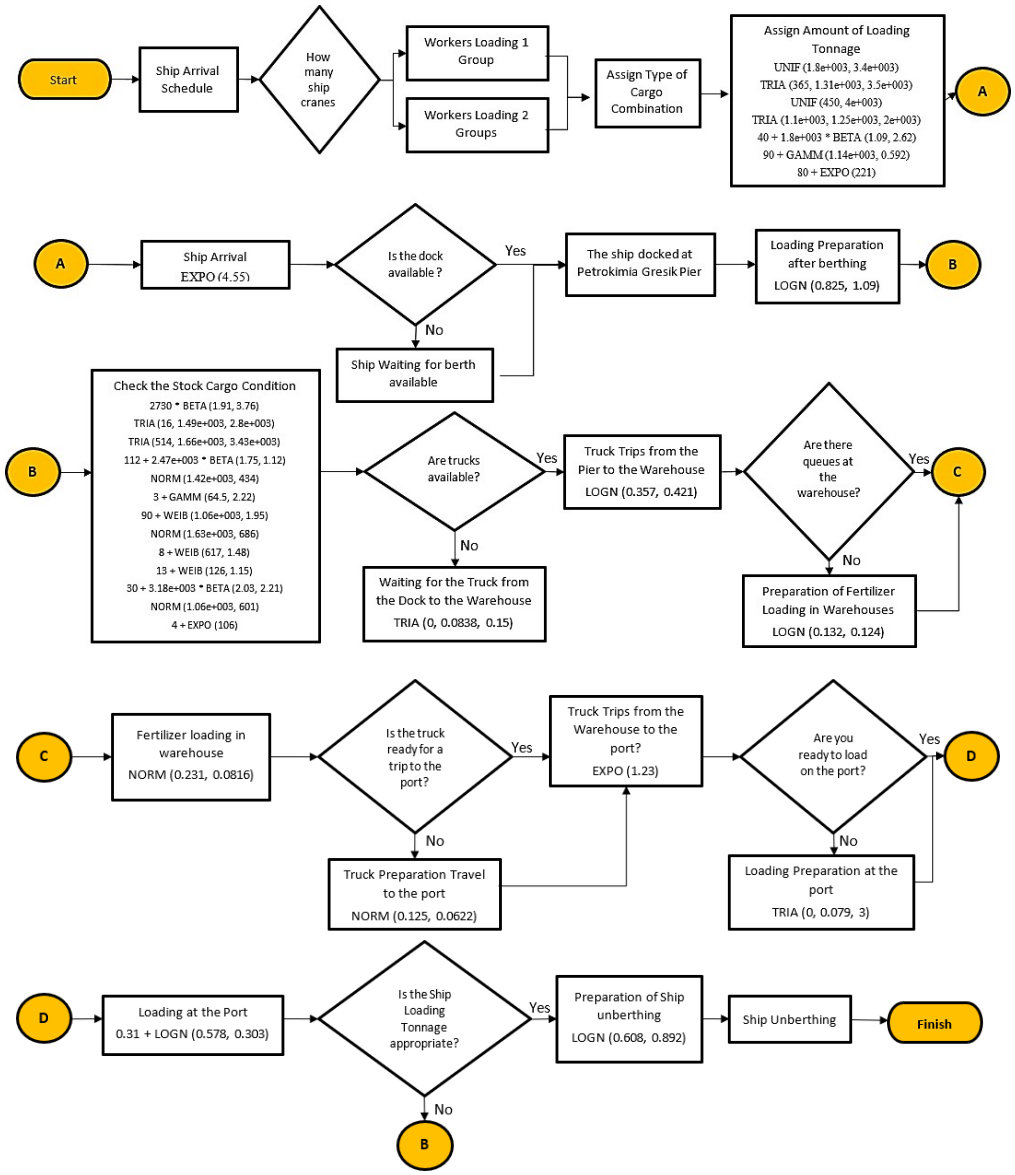

Figure 4. Simulation Model.

Table 1.
Proportion of loading activity

No.	Activity	Standard Deviation	*Average*	*Cumm*
A	Loading Preparation at the Jetty	0,84	29.35%	29.35%
B	Loading at the jetty	0,33	23.15%	52.50%
C	Travel the truck from the warehouse to the jetty	1,15	22.95%	75.45%
D	Travel the truck from the jetty to the warehouse	0,45	9.48%	84.93%
E	Fertilizer loading in the warehouse	0,07	6.28%	91.21%
F	Preparation for loading fertilizer in the warehouse	0,12	3.44%	94.65%
G	Wait for the truck to travel from the warehouse to the dock	0,06	3.10%	97.74%
H	Wait for the truck to travel from the dock to the warehouse	1,53E-16	2.26%	100.00%

port to serve ships was conducted by Vianen et al. [30]. The research encourages a methodology that is equipped with a simulation method to determine the size of the stockyard needed for a dry bulk dock. In order to identify the parameters that affect the storage capacity, a storage factor evaluation is done by calculating the ratio between the capacity to load the pier per year and the storage capacity of the stockyard. Furthermore,

The simulation is embodied to estimate the size of the stockyard, by considering several stochastic variations between the arrival times of the ship, the size of the ship, and the measurement of the storage time of dry bulk goods. Rizal [35] additionally implemented a simulation method in order to increase the speed of loading liquid goods with the aim of reducing the existence of demmurage costs. Rizal [35] exercised a discrete event simulation method in simulating the process of loading liquid goods at the port so that it can resemble the form of a real event. The results obtained are an alternative to the construction of a tank shipment at a shorter distance is the best alternative to increase the loading speed.

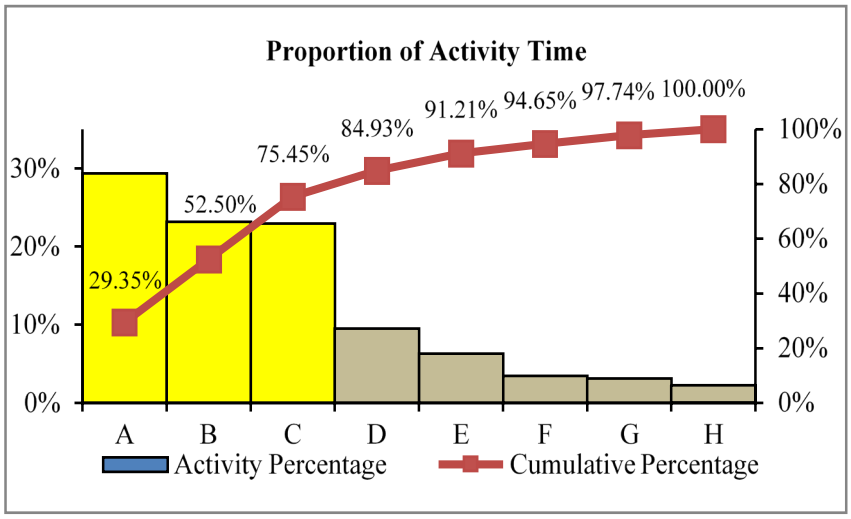

Figure 5. Pareto Analysis

Table 2.
5 (five) whys analysis

No.	Problems	*Why 1*	*Why 2*	*Why 3*	*Why 4*	*Why 5*
A.1	**The loading preparation time at the pier is too long**	Queued Trucks	The loading process takes a long time	Slow ship cranes	Ship cranes have decreased performance	There is no routine maintenance from the ship owner
A.2		Waiting for the truck at the loading point	The truck does not go directly to the loading point when the queue is finished	Truck drivers often leave the fleet while waiting in line	There is no Internal Officer to ensure that the truck driver must be in his fleet	Number of Personnel lacking supervision
A.3				Opening the truck tarpaulin takes a long time	The driver does not know how to open a tarpaulin effectively	New truck driver
B.1	**The truck trip from the warehouse to the dock takes a long time**	The truck stopped while on the way	The truck broke down in the middle of the road	Fleet is old	There are no new truck replacements	The number of trucks is limited
B.2			The truck does not go directly to the pier	The truck driver breaks	Lack of internal supervision in the field	Number of Personnel lacking supervision
B.3				The truck driver heads for the pool	Frequent driver changes	There are no definite driver hours worked by the vendor
B.4		The truck drove at low speed	Speed limit by K3 Petrokimia Gresik safety			
C.1	**Loading time at the dock takes a long time**	The loading method is not effective	Transfer of pallets from trucks to ships is quite long	The use of spreaders and nets for ineffective loading	Installation of spreaders and long and frequent meshes	Spreaders and meshes are only installed when the pallet is moved from the truck to the ship on the dock
C.2	**The loading time at the pier requires a long time**	The loading method is not effective	Transfer of pallets from trucks to ships is quite long	Slow ship cranes	Ship cranes have decreased performance	There is no maintenance of leave from the ship owner
C.3		Low loading labor union	Effective labor hours are low <18 hours per day	Labor breaks too often	Lack of internal supervision in the field	Number of Personnel lacking supervision

Activities in the loading process based on the system concept are stated as dynamic systems. This is caused by problems that occur in the loading process activities which are relatively complex and have high uncertainty. In the framework of the process of identifying and analyzing the loading system directly, it takes quite a long time and the costs are quite expensive. By describing the system in a model it is easier to study and analyze the loading system. The depiction of the model will represent and illustrate the loading system. To analyze the behavioral characteristics and characteristics in the loading system and its performance, it can be done through the description of the model using simulation methods. The use of simulation methods has been widely used in order to solve all kinds of process problems in the industrial field such as in the production process, management of stock availability in storage facilities, as well as in the shipping process. The positive impact of using simulation methods is that experiments with several different scenarios can be carried out without affecting the daily operational performance of the loading process [8].

From the results of previous studies, the discrete event simulation method will be comprised in research to overcome

Table 3.
FMEA Analysis

No.	Failure type	Root Cause	RPN								RPN Averages
			1	2	3	4	5	6	7	8	
A1; C2	The loading preparation at the pier takes a long time Loading time at the dock takes a long time	There is no routine maintenance from the ship owner	42	54	56	60	36	56	54	60	52,25
A2; B2; C3	The loading preparation at the pier takes a long time The truck trip from the warehouse to the dock takes a long time Loading time at the dock takes a long time	Number of Personnel lacking supervision	224	280	175	140	105	160	240	240	195,5
A3	The loading preparation at the pier takes a long time	New Driver	45	45	60	24	40	45	60	48	45,875
B1	The truck trip from the warehouse to the dock takes a long time	The number of trucks is limited	162	144	112	126	144	216	162	162	153,5
B3		There are no definite driver hours worked by the vendor	50	80	72	90	100	96	60	48	74,5
C1	Loading time at the dock takes a long time	Spreaders and meshes are only installed when the pallet is moved from the truck to the ship on the dock	140	200	200	162	216	128	175	160	172,625

Table 4.
Improvement Scenario

No.	Root Cause	Improvement Scenario
1.	The number of personnel is lacking in supervision.	The addition of personnel for supervision in each shift.
2.	The number of trucks is limited.	Adding trucks for loading activities.
3.	Use of spreaders and nets that are not effective.	Use a sling bag for loading.

Table 5.
Development of Improvement Scenario

Scenario	Combination	Improvement Scenario
0	0	Initial Conditions
1	1	The addition of personnel for supervision in each shift.
2	2	Adding trucks for loading activities
3	3	Use a sling bag for loading
4	1,2	The addition of personnel for supervision in each shift. Adding trucks for loading activities
5	1,3	The addition of personnel for supervision in each shift. Use a sling bag for loading
6	2,3	Adding trucks for loading activities Use a sling bag for loading
7	1,2,3	The addition of personnel for supervision in each shift. Adding trucks for loading activities Use a sling bag for loading

the problem of the slow loading speed of fertilizers in bag, as well as the problem of increasing loading costs borne by Petrochemical Gresik.

II. METHOD

We use simulation as research methodology. Simulation has been considered as an appropriate research method for modeling and experimenting complex system, including logistics and supply chain problems, where "what-if" analysis is necessary. Furthermore, simulation models are often when the characteristics of the supply chain are impractical and difficult to model with analytical approaches or when the systems incorporates stochastic variables and uncertainty, for instance in the case of complex inventory problems. There are a number of major steps carried out in this study. Figure 3 shows the four major steps where each will be explained in the following sections. The first step is developing the simulation model that started with the observation of real system, understanding the process, and collecting data for input parameters. In any simulation study, it is necessary to ensure that the model reflects the real system and the simulation logics works properly. Our second step, therefore, was verification and validation of the

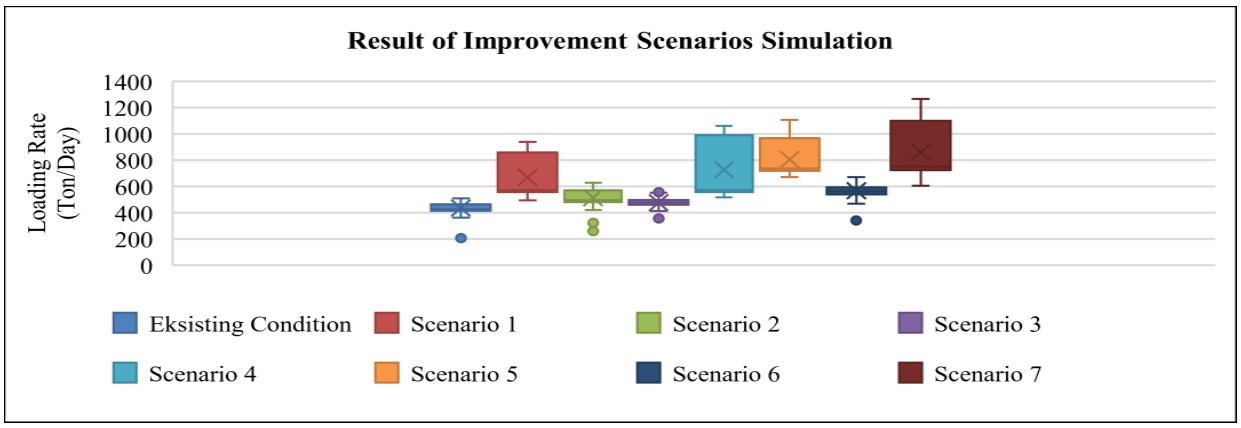

Figure 6. Result of improvement scenarios simulation

Table 6.
Result of Improvement Scenario

Scenario	Loading Rate (ton/day)	Savings (Rp)	Cost of Improvement (Rp)	ROI	PP
Eksisting Condition	435,06		-		
Scenario 1	668,29	1.439.428.152	858.000.000	68%	0,60
Scenario 2	513,78	157.641.939	2.640.000.000	-94%	16,75
Skenario 3	476,02	(221.667.116)	1.011.978.000	-122%	-
Scenario 4	724,42	1.820.497.329	3.938.000.000	-54%	2,16
Scenario 5	804,17	2.302.528.576	1.869.978.000	23%	0,81
Scenario 6	567,18	645.306.290	3.651.978.000	-82%	5,66
Scenario 7	858,78	2.598.306.908	4.509.978.000	-42%	1,74

simulation model. The third step was running the experiments following the full factorial design with five replications for each treatment.

Full factorial is a type of experimental design where all combination of factors are considered. The experimental results were used to evaluate which factors that have significant impacts on the two response variables (cost and service level) by the use of analysis of variance (ANOVA), Turkey kramer tes and the result of return of investment and payback period.

III. RESULT AND DISCUSSION

After conducting the process of collecting and processing data, all data are sought for distribution types and entered into the conceptual model to be converted into a simulation model using Arena 14.0 software. The simulation model is designed by inserting the loading process flowchart in Figure 4. The simulation model also contains data distribution to be able to describe in accordance with the conditions in the field.

From the simulation results that have been verified and validated, there is a load speed output derived from components that affect the output of the simulation such as preparation time for loading at the dock, loading time at the dock, truck travel time from warehouse to dock, truck travel time from dock to warehouse, fertilizer loading in the warehouse, preparation time for loading fertilizer in the warehouse, waiting time for truck trips from the dock to the warehouse, waiting time for truck trips from the dock to the warehouse. Table 1 and Figure 5 is the result of the pareto analysis of the simulation.

From Figure 5 and table 1 it can be concluded that there are three highest loading times namely preparation time for loading at the jetty, loading time at the jetty and truck travel time from warehouse to jetty. These three times are the highest cause of the low loading speed at Gresik Petrochemical Port. To find the causes of the three main problems, an analysis of 5 (five) whys is used. 5 whys analysis is an analysis technique to reveal the root causes of a problem. Table 2 is an analysis of 5 (five) whys of three main problems, namely preparation time for loading at a high pier, loading time at a high dock and travel time for trucks from the warehouse to the high dock.

FMEA Analysis (Failure Mode and Effect Analysis) is a step in the analysis to find the root causes that have been collected from the analysis of 5 (five) whys. The cause will be given from the level of severity, occurance and detection. With the analysis will generate priority numbers which risk from the cause. This priority determines the cause that is the focus of the scenario. The assessment at FMEA was carried out by distributing questionnaires to parties related to the loading of fertilizers in bag at Gresik Petrochemical Port. From the results of the distribution of the questionnaire will get an average value of severity (S), occurance (O) and detection (D) to subsequently obtain an RPN (Risk Priority Number) value. The questionnaire was distributed to 8 (eight) respondents who were experts with the process of loading fertilizers in bag. Experts who became respondents included the Head of Port Administration (section head) of one person, Kasi (section head) of one person loading and unloading supervisors, Karu (Head of Team) Port Administration of one person, the Youth Staff of Port Administration with two people, and There are three people who carry out the loading and unloading. The FMEA analysis is developed in Table 3.

From the results of the respondents in the FMEA analysis in table 3, we discovered 3 (three) dominant root causes, namely the number of personnel lacking in supervision, the

limited number of trucks, and the use of ineffective spreaders and nets. These three root causes are the basis for determining scenarios in improving the speed of in bag fertilizer loading at Gresik Petrochemical Port.

Scenarios need to be carried out to increase the speed of loading of fertilizers in bag at Gresik Petrochemical Port. The development of scenarios is based on the root cause of the low loading speed. Table 4 is an alternative development improvement scenario.

Repair scenarios are solutions for the root causes that cause slow loading speeds. This improvement was clarified to the company experts to be applied. Of the several improvement scenarios will not be directly submitted to the company but it is necessary to do a cost analysis from one improvement to another. The possibility to combine several improvement scenarios is also considered feasible in Table 5.

From 7 alternative scenarios, there are 4 alternative scenarios with output speed loading results above the company's KPI target (600 tons / day) of which are alternative scenario 1 with the result of loading speed of 668 tons / day, alternative scenario 4 with the result of loading speed of 724 ton / day, alternative scenario 5 with the result of loading speed of 804 ton/ day, and alternative scenario 7 with the result of loading speed of 858 ton / day. With the increase in average loading speed in one year, loading costs will be cheaper based on the Petrochemical Gresik work contract to the loading services partner.

Table 6 shows that alternative scenario 1 is the best result with a return of investment (ROI) reaching 68% in 1 year and a payback period (PP) of 0.60 years. The same is true for alternative scenario 5 which has a smaller ROI value of 23% in one year and the payback period value reaches 0.81 years but has a relatively high speed compared to Seknario 1. 2 (two) alternatives can be said to be good because it has a high ROI value in one year compared to other alternatives. If the company wants a high return on investment, scenario 1 can be chosen to be implemented because scenario 1 is the best scenario in terms of ROI, but if the company focuses on high loading speeds, scenario 5 can be an alternative scenario selection to be implemented at Petrokimia Gresik port.

IV. CONCLUSION AND RECOMMENDATION

The results of the study concluded that the factors causing the low speed of loading fertilizer in bag were the length of time for loading preparation at the pier which reached 29.35% of all loading activities, and the length of loading time at the pier which reached 23.15% of all loading activities and the length truck travel time from warehouse to dock reaches 22.95% of all loading activities.This study developed 7 improvement scenarios, with 3 main alternative scenarios including the addition of personnel for supervision in each shift, the utilization of sling bags for loading, the addition of trucks in loading activities and 4 other alternative scenarios are a combination of the main scenarios. After simulating all the scenarios, the conclusion is that the best scenario in terms of ROI is to add internal field supervisory personnel at each shift when loading fertilizer in bag. By implementing these alternatives the loading rate or loading speed can increase to 668.29 tons / day or increase 54% from the initial condition (existing). From the calculation of the feasibility of investment costs, a return of investment (ROI) of 68% is generated within 1 year and a payback period (PP) of 0.60 years. The best scenario in terms of loading speed is to add internal control and apply a new method of loading fertilizer using a sling bag. By implementing the alternative, the loading rate can increase to 804.17 tons / day with an ROI of 23% within one year and a PP value of 0.81 years.

ACKNOWLEDGEMENTS

The authors are very grateful to PT Petrokimia Gresik for all support, information and data in this study. We specifically thanks to Wahyudi Soekisno, Pannawati, Bagusdwipa, Hervi Novy, Agatha Aprinda, Deska & Edsel, Shandy Kharisma, Boy Cahyo, Bachtiar Rosihan, Iwan Febrianto, Candal Pelabuhan, Instrument Pelabuhan for all spirits support.

REFERENCES

[1]. A. Kadir, “Transportasi: peran dan dampaknya dalam pertumbuhan ekonomi nasional,” Jurnal Perencanaan & Pembangunan Wilayah, vol. 1, no. 3, pp. 120-131, 2006.
[2]. Jusna and T. Nempung, “Peran transportasi laut dalam menunjang arus barang dan orang di kecamatan Maligano Kabupaten Muna,” Jurnal Ekonomi, vol. 1, pp. 189-200, 2016.
[3]. Badan Pusat Statistik, “Pertumbuhan Ekonomi Indonesia Triwulan IV Tahun 2018,” Badan Pusat Statistik, 2018. [Online]. Available: https://www.bps.go.id/pressrelease/2019/02/06/1619/ekonomi-indonesia-2018-tumbuh-5-17-persen.html. [Accessed 10 Februari 2020].
[4]. R. F. Widyawati, “Analisis keterkaitan sektor pertanian dan pengaruhnya terhadap perekonomian Indonesia (analisis input output),” Jurnal Economia, vol. 13, no. 1, pp. 14-27, 2017.
[5]. Kementerian BUMN, “Situs Kementerian Badan Usaha Milik Negara Republik Indonesia,” 2019. [Online]. Available: http://bumn.go.id/pupukindonesia/berita/1-PETROKIMIA-GRESIK--LANDMARK-PROGRAM-TRANSFORMASI-MENUJU-SOLUSI-AGROINDUSTRI. [Accessed 11 Februari 2020].
[6]. S. Fatimah, Pengantar Transportasi, Ningsih, Ed., Ponorogo: Myria Publisher, 2019.
[7]. W. D. Kelton, R. P. Sandowski and N. B. Zupick, Simulation with Arena, New York: McGraw-Hill Education, 2015.
[8]. M. A. Law and D. W. Kelton, Simulation Modeling and Analaysis, 3rd ed., New York: McGraw-Hill, 2000.
[9]. J. Banks., J. Carson, B. L. Nelson and D. Nicol, Discrete-Event System Simulation, 4th ed., New Jersey: Prentice Hall, 2004. International Conference on Management of Technology, Innovation, and Project (MOTIP) 2020, July 25th, 2020, Surabaya
[10]. B. Khoshnevis, Discrete Systems Simulation, New York: McGraw-Hill, 1994.
[11]. R. Kissell and J. Poserina, “Advanced Math and Statistics,” in Optimal Sports Math, Statistics, and Fantasy, Cambridge, Academic Press, 2017, pp. 103-135.
[12]. D. F. Groebner, P. W. Shannon, P. C. Fry and K. D. Smith, Business Statistics, 8th ed., New Jersey: Prentice Hall, 2011.
[13]. J. M. Garrido and R. Schlesinger, Principles of Modern Operating Systems, Burlington: Jones & Bartlett Learning, 2008.
[14]. D. L. Allaire, “Uncertainty assessment of complex models with application to aviation environmental systems,” January 2010. [Online]. Available: https://www.researchgate.net/publication/40868486_Uncertainty_assessment_of_complex_models_with_application_to_aviation_environmental_systems. [Accessed 23 February 2020].
[15]. Ş. Çelik and M. Korkmaz, “Beta distribution and inferences about the beta functions,” Asian Journal of Science and Technology, vol. 07, no. 05, pp. 2960-2970, 2016.

[16]. G. R. Shorack and J. A. Wellner, Empirical Processes with Applications to Statistics, Philadelphia: Society for Industrial and Applied Mathematics, 2009.
[17]. K. Ahmad and S. P. Ahmad, "A comparative study of maximum likelihood estimation and bayesian estimation for Erlang distribution and its applications," 27 September 2019. [Online]. Available: https://www.intechopen.com/online-first/a-comparative-study-of-maximum-likelihood- estimation-and-bayesian-estimation-for-erlang-distribution. [Accessed 23 February 2020].
[18]. MIT, "Lecture 6 Gamma distribution, x2-distribution, student t-distribution, fisher f-distribution," September 2006. [Online]. Available: https://ocw.mit.edu/courses/mathematics/18-443-statistics-for-applications-fall-2006/lecture-notes/lecture6.pdf. [Accessed 23 February 2020].
[19]. A. Ahmed, J. Reshi and K. Mir, "Structural properties of size biased Gamma distribution," IOSR Journal of Mathematics, vol. 5, no. 2, pp. 55-61, 2013.
[20]. M. Ratnaparkhi, "Lognormal Distribution - Basic," 29 September 2014. [Online]. Available: https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781118445112.stat05889. [Accessed 23 February 2020].
[21]. A. Dasgupta and A. Wahed, Clinical Chemistry, Immunology and Laboratory Quality Control, New York: Elsevier, 2014.
[22]. A. J. J. Hallinan, "A Review of the Weibull Distribution," Journal of Quality Technology, vol. 25, no. 2, pp. 85-93, 1993.
[23]. C.-D. Lai, "Weibull Distributions and Their Applications," February 2006. [Online]. Available: https://www.researchgate.net/publication/37628953. [Accessed 23 February 2020].
[24]. A. Hidayat, "Tutorial Independen T Test dengan SPSS," 2014. [Online]. Available: https://www.statistikian.com/2014/04/independen-t-test- dengan-spss.html. [Accessed 9 Februari 2020].
[25]. D. F. Groebner, P. W. Shannon, P. W. Fry and K. D. Smith, Business Statistics, 8th ed., New Jersey: Prentice Hall, 2011.
[26]. V. H. Barros, A. C. M. T.S. Costa and L. A. N. Lorena, "Model and heurtistic for berth allocation in tidal bulk ports with stock level constraints,"Computer and Industrial Engineering, vol. 60, no. 4, pp. 606-613, 2011.
[27]. P. Sandborn, "Calculating the Return on Investment (ROI) for DMSMS Management," University of Maryland, 2010. [Online]. Available: http://escml.umd.edu/Papers/DMSMS_ROI.pdf. [Accessed 17 February 2020].
[28]. N. Umang, M. Bierlaire and I. Vacca, "Exact and heuristic methods to solve the berth allocation problem in bulk ports," Transportation Research Part E: Logistics and Transportation Review, vol. 54, pp. 14-31, 2013.
[29]. C. Harrell, B. Ghosh and R. Bowden, Simulation Using ProModel, 2nd ed., New York: McGraw-Hill, 2004.
[30]. T. v. Vianen, J. Ottjes dan G. Lodewijks, "Simulation-based determination of the required stockyard size for dry bulk terminals," Simulation Modelling Practice and Theory, vol. 42, pp. 119-128, 2014.
[31]. C. Agustina, "Sistem informasi perusahaan ekspedisi muatan kapal laut pada PT Tirang Jaya Samudera Semarang," Jurnal Bianglala Informatika, vol. 3, no. 1, pp. 1-9, 2015.
[32]. A. N. Dewi, H. Saptono and R. Njartijani, "Pertanggungjawaban ekspedisi muatan kapal laut (EMKL) dalam hal ganti kerugian atas kerusakan atau kehilangan barang kiriman melalui laut (di PT Danatrans Service Logistics Semarang)," Diponegoro Law Journal, vol. 6, no. 2, pp. 1-13, 2017.
[33]. A. W. Utama, "Analisis faktor-faktor yang mempengaruhi penundaan pengiriman barang melalui jalur laut," Jurnal Citra Widya Edukasi, vol. X, no. 2, pp. 97-108, 2018.
[34]. S. Robinson, A. Tolk, G. Arbez, G. Wagner and B. G. Louis, "CONCEPTUAL MODELING: DEFINITION, PURPOSE AND BENEFITS,"Proceedings of the Winter Simulation Conference , pp. 2812-2826, 2015.
[35]. H. Rizal, "SIMULASI PROSES PEMUATAN KAPAL DI PELABUHAN PT. WINA GRESIK DENGAN TUJUAN MENGURANGI DEMURRAGE," Prosiding Seminar Nasional Manajemen Teknologi XXII, 2015.
[36]. F. S. Hillier and G. J. Lieberman, Introduction to Operation Research, New York, McGraw-Hill International Edition,, 2005.
[37]. H. Uktoseya, "Simulasi Sistem Loading-Unloading Peti Kemas di Jakarta International Container Terminal," Tesis yang tidak dipublikasikan, 2002.
[38]. U. N, M. Bierlaire and I. Vacca, "Exact and heuristic methods to solve the berth allocation problem in bulk ports," Transportation Research Part E Volume 54, pp. 14-31, 2013.
[39]. D. W. Zimmerman, "A Note on Interpretation of the Paired-Samples t Test," Journal of Educational and Behavioral Statistics Vol.22, pp. 349-360, 1997.
[40]. S. F. B. Besley, Essentials of Managerial Finance, Birmingham: Dryden Pr, 2007.
[41]. R. Querton, Business Planning Made Simple, Ina Publikatama., 2002.
[42]. F. Rangkuti, Business Plan: Teknik Membuat Perencanaan Bisnis dan Analisis Kasus, Jakarta: PT. Gramedia Pustaa Utama, 2001.
[43]. A. R. Stephen, Pengantar Keuangan Perusahaan, Jakarta: Salemba Empat, 2009.
[44]. Sudaryono, Studi Kelayakan Bisnis, Jakarta: Lentera Ilmu Cendekia, 2015.International Conference on Management of Technology, Innovation, and Project (MOTIP) 2020 July 25th, 2020, Surabaya
[45]. A. Wibowo, "Metodologi Perhitungan Required Rate of Return Berdasarkan Cumulative Prospect Theory; Studi Kasus Proyek Investasi Jalan Tol,"Jurnal Teoritis dan Terapan Bidang Rekayasa Sipil, 2011.
[46]. M. Yenny, "Perencanaan Bisnis Jasa Multimedia Manajemen. Proceeding Call for Papers dan Seminar Nasional," Universitas Sebelas Maret (UNS) Solo, 2013.
[47]. K. Bichou and G. R. , "A Logistics and Supply Chain Management Approach to Port Performance Measurement," Maritime Policy & Management,pp. 47-67, 2004.
[48]. W. F. and L. X. , "A Multi-Objective Optimization for Green Supply Chain Network Design," Decision Support Systems, pp. 262-269, 2011.
[49]. F. Iannone, "Innovation in Port -Hinterland Connections. The case of campanian logistics system in southern italy," Maritime Economic & Logistics, pp. 33-72, 2012.