Risk Analysis in Mini Container Loading and Unloading Activities at Dock Company

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Abstract
This research examines the risk of Mini Container (MiniCon) loading and unloading activities at dock companies. The background of this research is based on the current capitalization of a market that gives impetus and increase to the demand for distribution of goods. The distribution of goods is mediated in the shipping logistics business industry using large container media. The dock company competes among several companies and is driven to innovate a Mini Container (MiniCon). Risk analysis on MiniCon's loading and unloading activities was carried out using the House of risk (HOR) and Monte Carlo methods. The House of Risk (HOR) method aims to identify the risks that exist in the company. Monte Carlo Simulation aims to see the suitability of events that have occurred with the results of the simulation. The results of this study include. First, the number of risks identified as many risk events with several factors causing risk events in HOR stage 1. HOR stage 2 through ARP assessment results in 2 risk factors. Second, Monte Carlo simulation Secondly, the Monte Carlo simulation generates 6 occurrences based on historical data. Significance results for several incidents are significantly compared to actual events.

Keywords
Risk Management, House Of Risk, Monte Carlo, and Mini Container

1. Introduction
Flow in a market capitalization give impetus to the demand for increasing the distribution of goods. The increase in the distribution of goods is mediated by the industry in the field of logistics, especially of shipping logistics services. An important role of the logistics industry has an impact on the smooth operation of trade, both for the domestic market as well as overseas markets.

Distribution of goods in logistics shipping containers typically use the media in the delivery of goods. Types of containers that are circulating are dominated by a large size or capacity. It aims to reduce the cost of delivery of goods during transit. As a state-owned company competing dominance among private companies both foreign and domestic compelled to make changes through innovation a Mini Container (MiniCon). The MiniCon was captured by the company as a positive opportunity in the loading and unloading process at the terminal. This is because, that logistical innovation is practical because it can be folded and sized one third smaller. Three MiniCons can be loaded into one 20 TEU container at a time.

Differences MiniCon and conventional containers or large capacity seen in a real application in the field, even though both are equally as media goods distribution. The side contrast of large containers, loading and unloading activities cause timeouts or dwelling time which is quite time consuming daily. Port dwelling time can be interpreted as the time needed for containers to be piled up at a Temporary Piling Place (TPS) / container yard in the port area / area, calculated from the time imported goods are unloaded from the ship until they are removed from the TPS (Basuki et al. 2015).

The application MiniCon in the port terminal is shown in Figure 1. MiniCon delivery is done with large container media by means of being inserted into large containers. MiniCon is then carried with a large container truck and the process of unloading through the distribution centre. It is different from the use of large containers that have to go through a distribution centre longer than MiniCon. During this stevedoring activity, MiniCon is directly transported with a smaller truck and sent directly to the destination.

There are several studies that have examined the use of a container in loading and unloading activities at the port. This research focuses on dwelling time, according to Kourounioti, Polydoropoulou, and Tsiklidis, states the effect of time on distribution activities refers to the terminal operator in predicting the waiting time and arrival of trucks for container picking (Kourounioti et al. 2016). Whereas by Dang and Chu, the focus is on conducting sustainable container testing as packaging that can be reused in the supply chain of shipping goods (Dang and Chu 2016). The next research, which focuses on risk management aims to look deeper into risks at the port terminal during the container unloading process. Chang and Hsun's research outlines three major logistics flows in container delivery operations. These three logistics streams are used to develop conceptual models and perform first-step risk management, risk identification, in container shipping operations (Chang 2013). Nguyen and Wang stated, that the research emphasized the identification of operational and priority risks in container delivery to uncover the potential of hazardous events (HE) in the container process pattern and the development of the logistics network (Nguyen and Wang 2018). In Chang, Xu, and Song risks in container shipments consist of risks related to information flow, risks related to physical flow, and risks related to payment flow (Chang et al. 2015). While Pallis risk identification leads to safety risk and natural risk (Pallis 2017). This is also in line with Chlomoudis, Pallis, & Tzannatos who identify the risks of safety and nature (Constantinos et al. 2016). In contrast to Shang & Tseng the risk of container loading and unloading operations is influenced by human factors (Shang and Tseng 2010). By Tseng, Ding and Li, not only explained the risks that have an impact on container damage due to loading and unloading operations, but also presented as a governance strategy from these risks (Tseng and Ding 2013). A similar pattern was also carried out by Kwak, in his dissertation the risks raised were related to international logistical operational risks (Kwak 2014). Still in risk management, Najib, Boukachour, & Fazziki in their journals emphasizes improving safety during the container operation process (Najib et al. 2013). The same thing in Naing, in the case of his research refers to safety management as a risk assessment (Naing 2018).

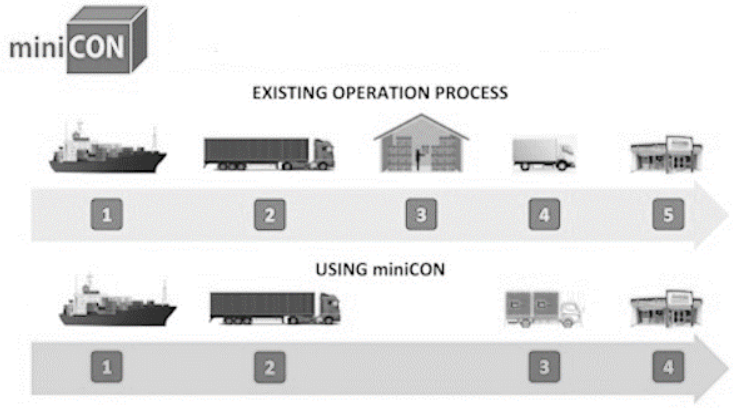

Figure 1. Mini container application
(Source: Dock Company)

Based on the background of the loading and unloading activities of MiniCon in the port terminal, this research aims to examine the risks that occur during the loading and unloading of MiniCon. The use of MiniCon is new to shipping logistics. Logistics activities with MiniCon have also been answered with excellence in terms of time efficiency, compact capacity. But some of these advantages are also in line with the risks that will be inflicted. This risk can also affect operational activities, resulting in an in optimization.

2. Methodology

The research process is carried out through several stages. That stage is observation stage, then identification and formulation of the problem, literature study, determination of scope, data collection, risk identification, risk mapping using the method used.

2.1. Observation Stage

The object of this study is the risk analysis of loading and unloading activities at the port terminal. The focus of this research is on loading and unloading activities using MiniCon. The loading and unloading process with MiniCon media is an activity that has just been carried out by the state-owned company. While the literature study in this research becomes a reference in finding the gap of a problem. Literature studies in this study are categorized into three scopes of discussion, namely the scope of dwelling time, container packaging, and risk management.

2.2. Data Collection Stage

Data collection in this study consisted of two data, primary data and secondary data. Primary data is data obtained through questionnaires and interviews from the company. The company part is a respodent or an expert in charge of carrying out MiniCon stevedoring operations. The number of respondents was five and was chosen based on their position and involvement in MiniCon operations. Secondary data is data derived from company reports, such as MiniCon description reports, incident reports during the year 2019, and other supporting reports.

2.3. Data Processing Stage

Data processing is carried out using the House of Risk (HOR) approach and monte carlo simulation as a method to assist risk analysis. Use of HOR further emphasizes deterministic properties at a risk. But the risk is also in uncertainty, so it takes stochastic and objective properties of the Monte Carlo simulation. HOR based through development from method of FMEA (Failure Mode and Effect Analysis) and method of QFD (Quality Function Deployment). The stages in this framework is consists of two phases, namely the identification phase of risk as the first phase and the phase of risk management as the second phase (Hariastuti 2014), HOR in the first phase is the stage of identifying risks, the output in this phase is the priority ranking of risk agents (Cahyani et al. 2016). In the first stage HOR model has several steps which include (Pujawan and Geraldin 2009):

1. To identify the risks that occur on the activities or business processes. HOR In the first phase, a risk event is placed on the left-hand column under the symbol Ei.
2. Perform assessments on the impact (severity) of the level of risk that has occurred. This risk assessment can use a scale of 1 to 10, of which a scale of 10 is a value that indicates a very severe impact.
3. Identifying the risk agent as well as giving assessment on possible levels (probability) generated from each risk agent. This assessment can use a scale of 1 to 10, where scale 10 is a possibility value that should have occurred.
4. Developing related matrix forms. The relation from each risk agent and each risk event is described by the form Rij {0, 1, 3, 9}. In the form of a value of 0 represents no correlation, while 1 lower correlated, 3 medium correlated, and 9 high correlated.
5. Perform calculations on aggregate potential risk (ARPj), $\mathbf{ARPj = Oj}\sum_i \quad S_i \mathbf{\ Rij}$
6. Rating the risk agent in accordance with the aggregate risk potential

HOR at the second phase of the risk management, the output of this phase in the form of an action plan risk prevention agent (Cahyani et al. 2016), In the second stage HOR model has several steps which include (Pujawan and Geraldin 2009):

1. Choosing the highest priority level of some risk agent, then perform the analysis with Pareto method of ARPj form.
2. To identify any actions deemed necessary to prevent the existence of risk agents.
3. Furthermore, determining the relations between every precaution against the risk of existing agents. It is also done assessments as Ejk {0, 1, 3, 9}. where the value of 0 represents no correlation. While the value of 1 lower correlated, 3 medium correlated, and 9 high correlated.
4. Performs total effectiveness calculations from each action with the calculation formula $TEk = \sum_j \quad ARPj\ Ejk \ \forall\ k$
5. Provides assessment of the level of difficulty in performing every action and puts the results of the assessment under total effectiveness. These levels of difficulty can be scale (as Likert scale or another scale).
6. Performs total effectiveness calculations for difficulty ratio with the calculation formula $ETDk = TEk\ /\ Dk$
7. Lastly, specify the priority level for each action (Rk). The priority level with a rank value of 1 is given for actions with the highest $ETDk$ value.

Monte Carlo simulation methods or approaches have seen many interpretations, accepting various definitions, therefore it can be stated that this method has been long and the process of evolution and development (Platon and Constantinescu 2014). Another term is Monte Carlo simulation is Sampling Simulation. Sampling simulation depicts the possible use of existing data as well as can be known distribution. This method is divided into several stages (Hutahaean 2018):

1. Creating a probability distribution for critical variables
2. Building a cumulative probability distribution for each variable in the first phase
3. Determining intervals from random numbers

4. Create a simulation from the series of experiments

2.4. Analysis Stage
The purpose of this analysis and risk discussion is to measure and assess data that has potential operational risk on the use of MiniCon in logistics activities. Further, measurements and assessments were carried out using a risk-weighted scale.

3. Results and Discussion
3.1. Mini Container
Mini container is an innovation created by the two of state-owned company. MiniCon has smaller dimensions with 1.9 meters for length, 1.9 meters for wide, and 2 meters for high. The type of MiniCon material used consisted of mild steel and aluminium with a weight of 650 kg. Process MiniCon use adapted to traffic conditions and roads in urban and rural areas are narrow, so that the freight will be more simples and flexible door to door. 2 units can be transported by Mid truck MiniCon

3.2. House of Risk
Business processes in loading and unloading MiniCon activities include the process of berthing, stevedoring, cargodoring, stacking, and delivery. Each of these processes has potential risks that occur during loading and unloading of mini containers. Risk identification from HOR phase 1 shows 27 risk agents and 84 risk events. This risk identification continues on the determination of ARP and ARP ranking or priority is done with a pareto approach. The use of pareto aims to find out which risk agent has a large influence on the risk incidents that occur. This pareto approach uses the 80:20 rule, where 20% risk agent influences the 80% risk event that arises. The results from pareto produce 42 risk agents is shown in Figure 2.

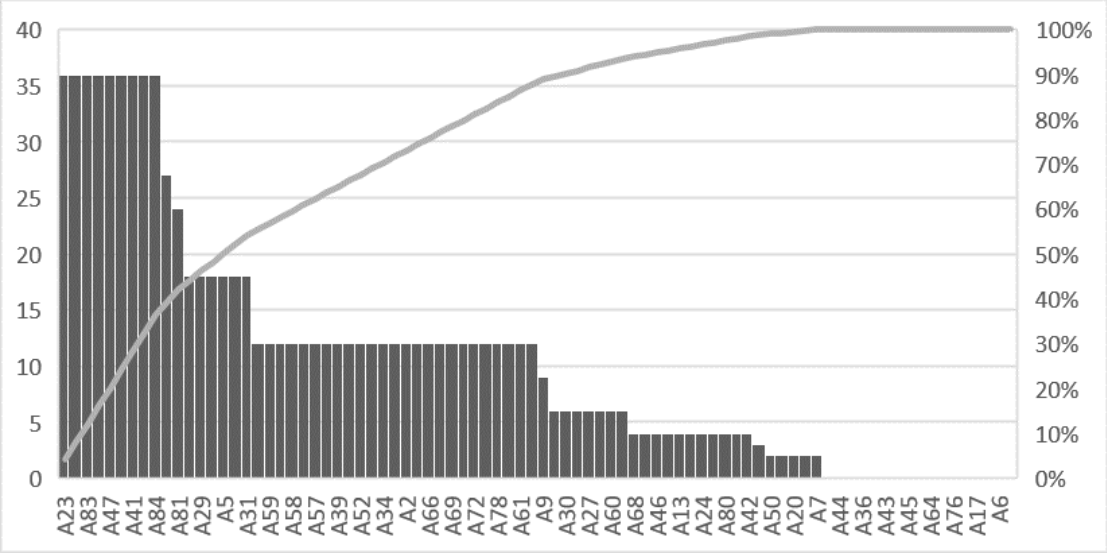

Figure 2. Aggregate potential risk

In HOR stage 2 shows 3 preventive actions. The results of the assessment of the correlation between preventive action with existing risk agents, produce a total effectiveness of each preventive action. Total effectiveness is a calculation to determine the effective level of implementation of preventive action in the company. These results are seen in Figure 3 below. The figure explains that the greatest value is at PA2 of 324. Second is PA1 of 108, and finally is PA3 of 108. Furthermore, the greater the value of total effectiveness influencing the priority of preventive action.

After the total effectivity assessment, the next step is to calculate the effectiveness ratio of difficulty. The value of the difficulty ratio indicates a priority in the implementation of preventive action. The results are in the look in Figure 4 below. The image explains that the largest value is at PA2 of 81. The second is the PA3 of 36, and the last is PA1 of 27.

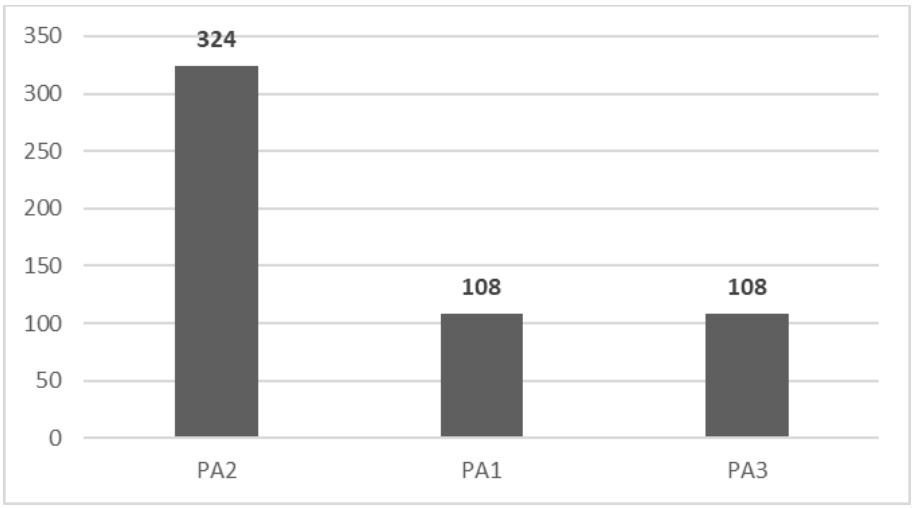

Figure 3. Total effectiveness value diagram

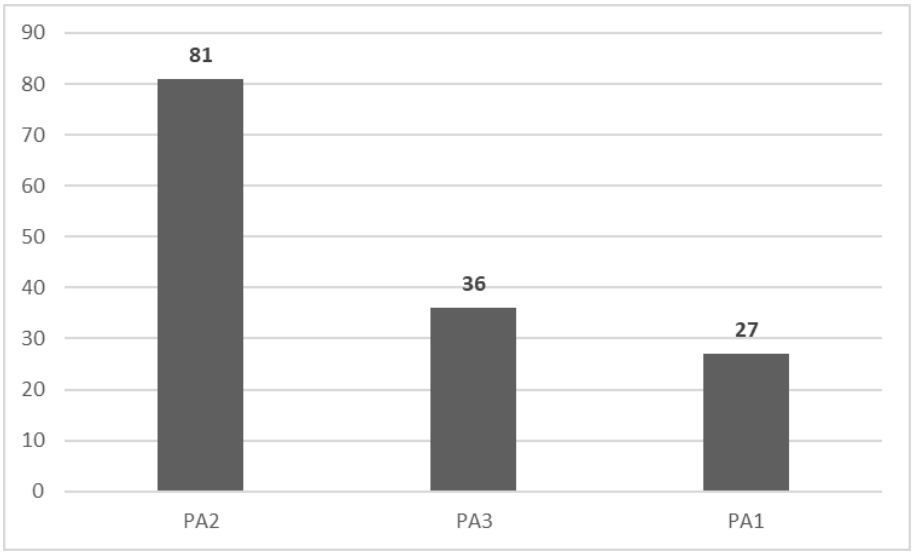

Figure 4. Effectiveness ratio of difficulty

3.3. Monte Carlo Simulation

The use of the Monte Carlo simulation is based on several risk events occurring during the loading and unloading activities in the port through historical data. The data shows a total of 6 incidents or risk events occurring during the year 2019. This Monte Carlo simulation starts at processing data from each incident. The result of data processing of each incident resulted in two types of distribution, namely beta and uniform as in Table 1 below.

The final stage of this simulation is explained through the results of the significance test on some incidents or incidents. The test results of simulated significance from the 6 incidents can be expressed as opposed to real (accepted) with actual events as in Table 2. The average result of each incident shows the F value of the simulated result in the F critical test area. In other words, hypotheses result in similarities to reality data.

Table 1. Distributions tables

No	RISK (ID)	Likelihood	Distribution
1	E4	0	BETA (5.45, 10.1)
		1	
2	E5	0	UNIF (0.99, 1.01)
		1	
3	E6	0	BETA (8.85, 12)
		1	
4	E8	0	BETA (5.45, 10.1)
		1	
5	E11	0	BETA (8.85, 12)
		1	
6	E26	0	BETA (8.85, 12)
		1	

Table 2. Results significance Monte Carlo Simulation

No	Risk List (ID)	Result
1	E4	Accepted
2	E5	Accepted
3	E6	Accepted
4	E8	Accepted
5	E11	Accepted
6	E26	Accepted

4. Conclusion

The operational activity of MiniCon loading and unloading in port terminals is identified by 27 risk events with 87 factors causing risk occurrence at HOR Phase 1. Based on the number of event identification in HOR Phase 1 conducted assessment with ARP. The assessment was followed by the use of a Pareto diagram which resulted in 2 causal factors and 3 preventive action in HOR Phase 2. Later in the Monte Carlo simulation, this simulation is based on events or incidents that occur historically on the loading and unloading activities in the company. Events generated during the unloading business activities of 6 events. From the incident, this simulation is done by probability and produce two types of distribution, namely Beta and Uniform. Whereas the significance of the probability of occurrence of events with actual events (historically) is expressed as opposed to real (accepted) with actual events on each incident. This research raises new things in the operation of unloading operations, i.e. the use of a MiniCon. Thus, this study still has limitations on the deficiencies in sample data. Upcoming research can be done again if the data has accumulated more. In addition, on the use of methods used for future research, can use better methods.

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