RISK ASSESSMENT BASED ON BUSINESS CONTINUITY MANAGEMENT: A CASE IN A HARBOR TUG SHIPPING COMPANY

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ABSTRACT

The high frequency of shipping in Indonesia causes an increasing port activities. This is related to the increased risk or accidents that can occur. The impact of an accident can be detrimental to many parties such as crew, company, ship, cargo carried, and environment. The high number of accidents encourages companies to apply the Business Continuity Management (BCM) system to deal with any potential accident that will occur. BCM includes Business Continuous Plans (BCP) that can handle every potential accident in a company. Several stages in conducting risk assessment are: identification of each risk that is in PT. X, a harbor tug shipping company in Indonesia, grouping each risk, and conducting risk assessment with best worst method (BWM). In undertaking risk identification, systematic questionnaire and interviews were used. The results of the risk assessment based on BCP found that the risk of experiencing a deviation in stages from the highest is: a tugboat collision with a value of 0.61; changes in customer tastes with a value of 0.45; engine failure on ships with a value of 0.45; and the availability of delayed parts with a value of 0.39. Therefore, this study may conclude that the highest deviation value or risk level of this entity is tugboat collision.

Keywords: Best worst method, business continuity management, risk assessment

1. INTRODUCTION

The port is a facility at the end of the ocean, lake and river to receive ships and move cargo or passenger goods. In the port there are also various types of ships. There are several types of ships that we often encounter in ports such as Container ships, General Cargo, Passenger, RORO, Ferry, and Harbor Tug. When the ship wants to dock, the ship needs Harbor Tug assistance. Harbor Tug is a ship that can be used to carry out maneuvers / movements, mainly pulling or pushing other vessels in ports, the high seas or through rivers or canals. The high shipping frequency in Indonesia

and the density of ships going in and out of ports for loading and unloading of cargo are carried out, making high ship accidents and accidents on the crew of the ship.

The high number of accidents encourages companies or organizations to apply the Business Continuity Management (BCM) system to prepare for any possible accident. Because in BCM, Business Continuous Plans (BCP) it can handle every possible accident that occurs within the company. BCM's life cycle consists of six elements, namely BCM program management, understanding the organization, determining and identifying BCM strategies, developing and implementing BCM responses, instilling BCM in organizational culture and also training, training, maintaining and reviewing BCM plans. The purpose of BCM is to identify a disaster or accident in a company and BCM also provides plans that are used when a disaster occurs.

2. LITERATURE REVIEW

2.1 Business continuity management

The Business Continuity Management System (BCMS) standard according to ISO 22301: 2012 stipulates that the requirements for planning, building, implementing, operating, monitoring, reviewing, maintaining and continuously improving a documented management system to protect, reduce the possibility of occurring, preparing, responding, and recover from disturbing incidents when they arise. BCMS performance depends on the implementation of BCMS requirements that cover the organizational context, leadership commitment, planning, and support. Operational requirements, performance evaluation, and improvement (Okuna, 2014). Risk management consists of a risk assessment process, risk communication, and risk treatment. Risk management tends to be preventive, while BCM tends to deal more with consequences. The risk management process provides important input for BCM and relates to risk control.

On the other hand, BCM goes beyond risk management to plan inevitable disasters. BCM was used to prevent serious interference and to reduce the impact of disturbances. BCM was designed to provide safety for humans and the environment, minimize operating disruptions, reduce damage, maintain service user service standards, maintain product quality, reduce legal exposure and comply with regulations. Risk management is the basis of BCM and provides basic analysis and decision making in decisions regarding resource allocation. Management risk is a continuous decision-making process that results in how risks are treated, whether received, avoided, reduced or transferred. When an organization experiences business interruption and causes losses then to reduce such losses, steps can be taken to guarantee the continuity of business processes and in general these steps are divided into four parts, these are:

1. Protection measures, to maintain the system from disturbing events and prevent damage to the system. If the protection measures are successful, the business process will not be disrupted.
2. Mitigation steps, which are automatically activated when the protection step is fail and the initial damage has been caused by a disturbing event. The purpose of the mitigation step is to make changes from disruptive events in the initial stages of development, so that damage can be reduced.
3. Emergency actions, which occur when failed mitigation measures will contain damage, and often require significant human intervention.
4. Step recovery, which aims to rebuild normal operations.

BCMS performance depends on the implementation of BCMS requirements that cover organizational context, leadership commitment, planning, support, operational requirements, evaluation and performance improvement (Torabi, 2016).

2.2 Business continuity plan (BCP)

Business continuity plan is a process of maintenance or repair in operations including servis to customers, when facing adverse events such as natural disasters, technological operation errors, human error or terrorism. The purpose of the business continuity plan (BCP) is to minimize the company's financial losses, provide services to customers and members of business actors, and mitigate negative impacts that can disturb companies in terms of strategic plans, corporate reputation, operations, liquidity, credit quality, the position of the company in the market and the ability to comply with the rules in accordance with applicable law.

Management's role in BCP is to prepare BCP for a company that cannot be done carelessly. In BCP planning requires special planning to consider the impacts that will occur. Some things that must be considered in doing BCP are:

a) Identify and approve all emergency responsibilities and procedures
b) Execution of emergency procedures can facilitate emergency planning and recovery of operations effectively on the required time scale.
c) Documentation of agreed procedures and processes
d) Appropriate knowledge of staff in agreed procedures and emergency processes including reactive management
e) Test and update plans;
f) The planning process must focus on the business objectives needed.
g) The planning process must also focus on the resources needed to enable it to occur, including staff, and reverse arrangements for data and information on processing facilities.

The BCP framework was made using a common format, to ensure that all plans are appropriate and to determine the priorities of testing and maintenance. Each plan must be clearly defined the conditions under which the plan will be carried out, and the person responsible for carrying out each plan. When new requirements are identified, the establishment of an emergency procedure, for example an evacuation plan or anything that changes, the BCP must be renewed. Different approaches may be needed for each service, business function or part of the organization, it is recommended to add a plan to the additional parts added.

A company must do BCP for all fields in the company. In one company BCP considers every important aspect of the business in planning how long BCP can respond to disturbances. When making BCP does not take into account any important aspects that exist, including members, workspace and other similar problems, the company may not be able to service consumers at an acceptable level.

2.3 Risk assessment (RA)

The definition of risk according to the International Standard Organization (ISO) is a combination of all types of opportunities and consequences for an event. All types of opportunities and consequences of events can be beneficial and detrimental. At security or safety risks, all types of opportunities and consequences of the events analyzed are in the form of adverse events called hazards or hazards. At the risk of the company or enterprise risk, all types of opportunities and consequences of events analyzed are the types of events that are beneficial and adverse. (ISO / IEC, 2009).

According to the IRM (Institute of Risk Management), risk analysis is all processes that involve overall risk analysis and evaluation. The company's risk analysis is carried out to identify company uncertainties in facing internal and external risk factors. These internal and external risk factors both cover financial risk, strategic risk, operational risk (operational risk) and hazard risk. Internal factors

faced by the company include corporate cash flow, research and development, intellectual capital, accounting supervision, information systems, public access, employees, assets, products and services. External factors faced by the company include interest rates, foreign exchange markets, competition, customer demand, customer changes, industry changes, regulation, culture, environment and natural events (IRM, 2002).

2.4 Business impact analysis

The planning process must also focus on the resources needed to enable it to occur, including staff, as well as reverse arrangements for data and information on processing facilities. BIA (Business Impact Analysis) is a process for analyzing basic functions and the consequences of disturbances that may occur in these functions. The main purpose of the BIA is to collect and analyze information needed to prepare BCP.

BIA refers to the steps taken by a business in identifying its basic functions and things that can affect these basic functions. Before starting a BIA, a business must identify a hierarchy or sequence of internal succession. After the succession sequence is clearly defined, the business can then identify its basic functions. Basic functions are the core activities of a business that are usually incorporated in a business mission statement. BCP can include terminating certain important functions and storing other people during an emergency, depending on the situation and priority given to that function. Some examples of important business functions include:

a. Send goods to clients
b. Keeping construction crew member safe while at the construction site
c. Maintain service standards
d. Protect client records

Once a business identifies all its important functions, it must assess how much the level of disruption will affect the business's ability to function. For each basic function, the business must determine the severity of the impact created by an event that will create a small, moderate, or significant disruption to the basic function. Measuring the severity must estimate the maximum allowable downtime for the business process in the critical phase, the purpose of the recovery point and the intended transaction, and the costs associated with downtime. Management must set recovery priorities for important business processes, personnel, technology, facilities, communication systems, vital records, and data. BIA also considers the impact of legal and regulatory requirements such as the privacy and availability of customer data and necessary notifications to the main federation and customers when the facility is moved.

The person responsible for this phase should consider conducting interviews with questions that can be used as a basis for developing the company. Question level uniformity for all parts of the company can improve the consistency of responses and help people involved in the BIA phase to compare and evaluate business process requirements. This phase can initially prioritize business processes based on their importance for achieving the company's strategic goals and maintaining safe and sound practices. However, this prioritization must be reviewed after business processes are modeled against various threat scenarios so that the BCP can be developed.

2.5 Multi criteria decision making (MSDM) and SPSS

Multi Criteria Decision Making (MCDM) is a decision-making technique of several alternatives based on certain criteria (Raharjo, 2000). Some examples of methods including MCDM are Analytical Hierarchy Process (AHP) (Rahmayani, 2016) Preference Ranking of Organization Method for Enrichment Evaluation (PROMETHEE) (Zhaoxu, 2010), Technique for Order

Preference by Similarity to Ideal Solution (TOPSIS), Elimination Et Choix Traduisant la Realite (ELECTRE) (Khamehchi, 2016)) and several other methods. However, this study will use the latest method, Best-Worst Method (BWM), which is one method that can be used in making a decision (Jafar 2016).

SPSS (Statistical Product and Service Solution) is an application program used to perform statistical calculations using computers. The advantage of this program is that it can perform statistical calculations faster from simple counts to very difficult counts. In using SPSS software, users only need to design variables that will be analyzed, enter data, and perform calculations using each step needed for processing data available on the menu. Then do the data interpretation after the calculation is complete. In conducting data interpretation, it is necessary to understand statistical understanding and research methodology (Sarwono, 2006).

3. RESEARCH METHOD

The following figure (Figure 1) provides research flow of steps implemented in this study. Risk identification is defined as the process of finding, recognizing and recording risks. Identifying risks determines the risks that might affect the organization being considered. In this way, decision makers become aware of events that can disrupt the organization through a risk identification process. At this is a questionnaires are distributed to managers and employees at PT. X to get the risk data that occurs in the company.

At the risk analysis step, a numerical value was determined for each risk identified as the level (ie value) of the risk, which is a multiple of the possible risks and the consequences. Risk were analyzed using data derived from questionnaires using Best Worst Method (BWM) and Center of Area (COA) methods. Calculations with BWM can be done using the following formula:

$$Ii = \sum_{j-1}^{3} W_j . a_{ij} \tag{1}$$

Where: li, w_j, a_{ij} are the risk impacts, the weight of the sub-factor, the risk score respectively at the interval [0,1]. After possible risks are analyzed, appropriate measures must be chosen to address them. At this stage, the results of BIA and RA are combined to identify risks that can cause deviations in the organization's goals more than the predetermined maximum deviation (i.e. risk appetite). In addition, finding the relationship between the main functions and identified risks helps the organization to find these risks with adverse effects on the objectives and prepare a plan of action needed to overcome them. The process of evaluating the results of risk analysis using Best Worst Method (BWM).

$$\beta_{ik} = \theta_{ik} . I_i . L_i \forall i, k \tag{2}$$

Where $\theta_{ik} . Ii . Li$ is I_i and L_i represent the level of vulnerability of resources k to the risk, impact of risk and possible risks of each.

$$\pi i = \sum_j \sum_g v' g v_{jg}, \max \langle \beta_{ik} \rangle \forall i, k \tag{3}$$

Where πi is showing the deviation of organizational goals after the occurrence of risk and v_{0g} and v_{jg} are the degree of importance of organizational goals and functions j

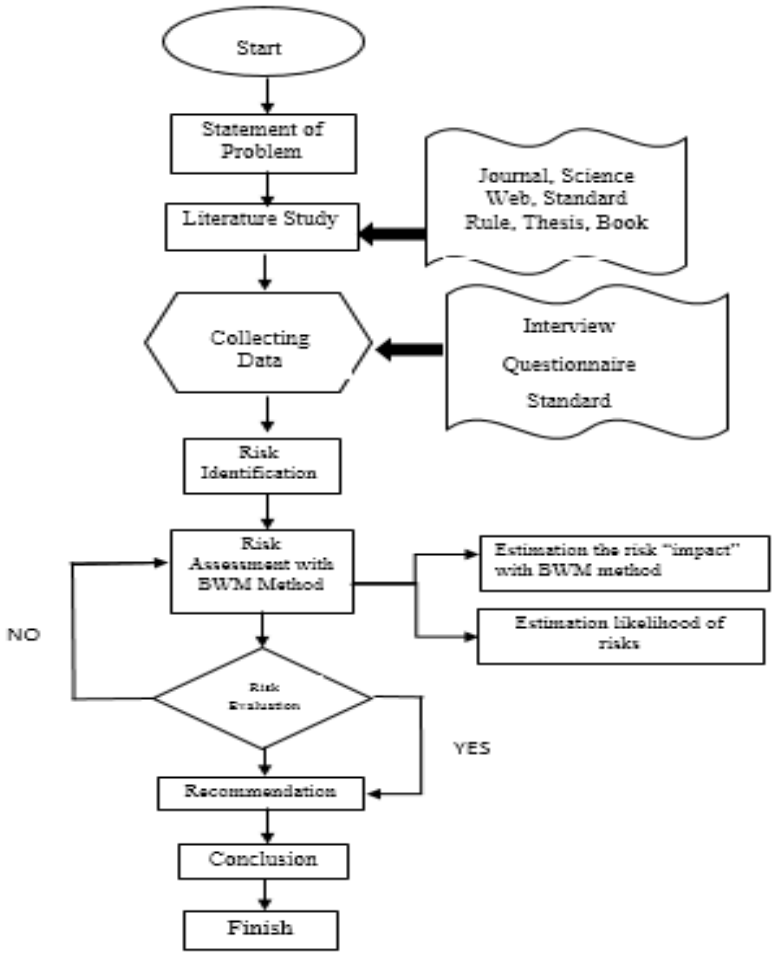

Figure 1. Research flow

4. RESULTS AND DISCUSSION

4.1 Risk Identification

The risk identification process is carried out to find out how much effect the company has if the risk occurs. Risk can be interpreted as a measure of the potential loss of a system / process / asset or object in other activities (Buda & Dinariyana 2013). Hazard identification and risk evaluation are defined as safety assessment steps (Zaman et.al, 2014). Risk can be seen from various aspects such as nature, environment, information technology systems, human resources, and operational risks. To find out what risks might occur, possible risks must be lists. The risk identification process is carried out by making a risk register based on the risk register as propose by Torabi et al (2016) for a harbor tug shipping as a case (PT. X).

4.2 Risk assessment

Further, in the implementation of digital port services in Indonesia taken the case of marine service of Tanjung Priok, it reported that positive benefit may be available both for port operators and users considering factors of transaction, safety, visibility, service and data reliability. Customers are now able to have a transaction of port and marine service at any locations they may access to. Risk assessment is very important to prevent loss in a company. Risk assessment can be interpreted

as a process and method of quantitative / qualitative approaches to determine the frequency of occurrence of hazards and processes and methods to estimate the possible consequences if these hazards arise (Buda & Dinariyana 2013). In assessing any type of risk within the company, a data collection on risks and the selection of risks are very influential if this occurs. After the risk selection is done by the manager and deputy managers of PT. X, a result 13 risks to be chosen due to its high influences to the company, then 13 types of risks were chosen that were very influential on the company. The risks that have been chosen are as follows:

Table 4.1 Result of Selection Risk

Risk
Work accident on the boat
Lack of crew numbers
Lack of expertise of the ship's crew
Theft of various equipment on board
Changes in customer tastes
Delay of ship delay services
Tugboat collision
Ship fire
Engine failure on the ship
Ship delay machining failure (towing machineries)
Delay in repairing tugs
Delayed arrival of spare parts
High fuel prices

The results of the selection of risks that have been selected are processed using the questionnaire method. The questionnaire will be shared with managers and deputy managers of PT. X to determine the value of each risk. In the risk assessment criteria as a reference or parameter for assessment in each scenario are needed. There are three main criteria used, namely risk factors that adversely affect the operation of guide services, the level of inability to detect risks before they occur, and the frequency of risk events at the ship delay service company. After doing the questionnaire and getting data from the results of filling out the questionnaire, data validation was carried out on the results of the questionnaire obtained. Then the validation is done using SPSS software to get the validity of each value filled in by the respondent.

Validation test is undertaken to have a correlation analysis in particular to correlate each question of the questionnaire with the value of each question contained in the questionnaire (Trihendari, 2013). After the results is obtained from validated, then selection of reliability level is further continued to get the value of each risk from 30 respondents by choosing the preferable value chosen by respondents. The following are the results of the selection of respondents particularly by the manager and deputy manager of PT.X.

Table 4.2. Results of risk assessment by respondents

Risk	F1	F2	F3	Likelihood
Work accident on the boat	0.8	0.3	0.1	0.1
Lack of crew numbers	0.6	0.1	0.1	0.2

Lack of expertise of the ship's crew	0.7	0.2	0.1	0.4
Theft of various equipment on board.	0.7	0.6	0.1	0.1
Changes in customer tastes	0.7	0.5	0.2	0.8
Delay of ship delay services	0.8	0.6	0.1	0.1
Tugboat collision	0.8	0.8	0.1	0.9
Ship fire	1	0.9	0	0.1
Engine failure on the ship	0.9	0.2	0.1	0.7
Ship delay machining failure (towing machineries)	0.9	0.1	0.2	0.1
Delay in repairing tugs	0.8	0.8	0.2	0.1
Delayed arrival of spare parts	0.8	0.6	0.2	0.6
High fuel prices	0.7	0.3	0.3	0.5

Then a weighting assessment is carried out on the criteria. Assessment is carried out using the AHP (Analytic Hierarchy Process) method. The following is the result of weighting the criteria after calculation using expert choice. The results of the assessment are obtained by weight each criterion shown in Figure 4.1 The biggest weight obtained from the weight of results is causing other risks or adversely affecting the operational of 0.736 or 73.6%. the weighting results for the inability to detect risks before they occur are 0.199 or 19.9%, and for the smallest weighting result is the risk growth of 0.065 or 6.5%. In this case it can be assume that causing other risks or having a negative impact on operations, and "inability to detect risks before they occur" are more important and significant than the "risk growth".

The weighting value is obtained from the results of the assessment by the manager and the weighting results. The values obtained are w1 = 0.736, w2 = 0.199, w3 = 0.065. After determining the number of sub-factors of the risk impact, this sub-factor must be combined with the appropriate function. For this, this sub-factor must be prioritized according to its importance from the manager's perspective. To analyze the risk, use the formula 1. The following are the results of the risk analysis calculation.

Table 4.3 Results of the risk analysis calculation

Risk	The Impact Risk
Work accident on the boat	0.066
Lack of crew numbers	0.094
Lack of expertise of the ship's crew	0.225
Theft of various equipment on board	0.064
Changes in customer tastes	0.502

Delay of ship delay services	0.071
Tugboat collision	0.679
Ship fire	0.092
Engine failure on the ship	0.496
Ship delay machining failure (towing machineries)	0.070
Delay in repairing tugs	0.076
Delayed arrival of spare parts	0.433
High fuel prices	0.297

After obtaining the criteria weights, it's then ranked to find out which risks are most influential to the company. The following are the results of risk ranking:

Table 4.4 Results of risk ranking

Risk	The Impact Risk
Work accident on the boat	0.4239
Lack of crew numbers	0.3176
Lack of expertise of the ship's crew	0.2712
Theft of various equipment on board	0.2457
Changes in customer tastes	0.189
Delay of ship delay services	0.1164
Tugboat collision	0.0525
Ship fire	0.0522
Engine failure on the ship	0.0502
Delay in repairing tugs	0.0391
Delayed arrival of spare parts	0.0357
High fuel prices	0.0346

From the table above it can be concluded that according to the managers of PT. X the highest risk for their company in the event of the following risks:

1. Work accident on the boat
2. Lack of crew numbers
3. Lack of expertise of the ship's crew
4. Theft of various equipment on board
5. Changes in customer tastes

4.3 Risk evaluation

After analyzing the risks that may occur at PT. X, the appropriate action should be determined to overcome them. In general, companies have limited resources in responding to risks. Therefore, a manager needs to know which risks having higher impact on organizational goals in managing limited resources when responding to risks. At this stage, BIA and RA results are

combined to identify risks that can cause deviations in the organization's goals. In addition, finding the relationship between the main functions and identified risk can help organization to find which risks with adverse effects on the objectives after company to prepare action to overcome it. When risks occur, it is necessary to calculate deviations from objectives and the impact of risks on resource considered. To calculate the number of deviations from the objectives and the impact of risks on resources considered. Risks may have a high impact and possibility but may not affect the source.

Therefore, the effects of the risks identified on organizational resources depend on the vulnerability of these resources. In determining the value of vulnerability in risk evaluation a questionnaire is required. The questionnaire will be shared with the manager and deputy manager of PT. X to determine the value of each risk. In evaluating risk, resources are needed as a reference or parameter in assessing their vulnerability. The resources used consist of 3, namely vulnerability to human resources, vulnerability to business profits and burdens, and vulnerability to service facilities. After doing the questionnaire and getting data from the results of filling out the questionnaire, data validation was carried out on the results of the questionnaire obtained. Then the validation is done using SPSS software to get the validity of each value filled in by the respondent. Validation test is a correlation analysis in particular the person to correlate each question in the questionnaire with the value of each question contained in the questionnaire (Okuna 2014).

Following are the steps in validating the values on the results of the questionnaire that have been carried out at PT. X. After the results of validation and reliability were obtained, the selection was done to get the value of each risk from 30 respondents by choosing the value most chosen by the respondents. The following are the results of vulnerability assessments carried out by the manager and deputy manager of PT. X.

Table 4.5 Results of the vulnerability assessment conducted by the manager and deputy manager of PT. X.

Risk	Vulnerability to human resources	Vulnerability to business profits and burdens	Vulnerability to service facilities
Work accident on the boat	0.8	0.7	0.7
Lack of crew numbers	0.1	0.4	0.5
Lack of expertise of the ship's crew	0.5	0.5	0.5
Theft of various equipment on board	0.4	0.7	0.7
Changes in customer tastes	0.1	0.7	0.5
Delay of ship delay services	0.1	0.9	0.5
Tugboat collision	0.9	0.9	0.8
Ship fire	0.9	1	1
Engine failure on the ship	0.9	0.9	0.7
Ship delay machining failure (towing machineries)	0.2	0.9	0.8
Delay in repairing tugs	0.3	0.7	0.8

Delayed arrival of spare parts	0.3	0.7	0.8
High fuel prices	0	0.6	0.7

Calculations were used using formula 2, where the value of $\theta_{ik}.Ji.Li$ is known. The following is result of the calculation performed to find the value of risk analysis.

Table 4.6 Calculation results to get the value of vulnerability.

Risk	Vulnerability to human resources	Vulnerability to business profits and burdens	Vulnerability to service facilities
Work accident on the boat	0.05	0.07	0.05
Lack of crew numbers	0.01	0.09	0.05
Lack of expertise of the ship's crew	0.11	0.22	0.11
Theft of various equipment on board	0.03	0.06	0.04
Changes in customer tastes	0.05	0.50	0.25
Delay of ship delay services	0.01	0.07	0.04
Tugboat collision	0.61	0.68	0.54
Ship fire	0.08	0.09	0.09
Engine failure on the ship	0.45	0.50	0.35
Ship delay machining failure (towing machineries)	0.01	0.07	0.06
Delay in repairing tugs	0.02	0.08	0.06
Delayed arrival of spare parts	0.13	0.43	0.35
High fuel prices	0.00	0.30	0.21

Then the deviation value can be done using formula 3. The company has 3 main goals, namely:

1. Increase customer satisfaction with an importance level of 0.4
2. Revenues are met with a level of importance 0.3
3. Increase the area with an importance level of 0.3

Table 4.7 Results of the calculation of risk deviations.

Risk	Deviation
Tugboat collision	0.61
Changes in customer tastes	0.45
Engine failure on the ship	0.45
Theft of various equipment on board	0.39
High fuel prices	0.27
Lack of expertise of the ship's crew	0.20
Lack of crew numbers	0.08
Ship fire	0.08
Delay in repairing tugs	0.07
Delayed arrival of spare parts	0.06
Ship delay machining failure (towing machineries)	0.06
Work accident on the boat	0.06
Theft of various equipment on board	0.06

Then a risk assessment is carried out to determine which risks should be mitigated, according to the Pareto principle commonly known as 80/20 rule of vital part law or the principle of pareto factors. Where if the risk value is below 80% mitigation is required to be applied.

Table 4.8 Results of the Pareto principle assessment

Risk	Deviation	Cumulative	% Risk
Tugboat collision	0.61	0.61	21%
Changes in customer tastes	0.45	1.06	37%
Engine failure on the ship	0.45	1.51	53%
Theft of various equipment on board	0.39	1.90	67%
High fuel prices	0.27	2.17	76%
Lack of expertise of the ship's crew	0.20	2.37	83%

Lack of crew numbers	0.08	2.45	86%
Ship fire	0.08	2.54	89%
Delay in repairing tugs	0.07	2.60	91%
Delayed arrival of spare parts	0.06	2.67	94%
Ship delay machining failure (towing machineries)	0.06	2.73	96%
Work accident on the boat	0.06	2.79	98%
Theft of various equipment on board	0.06	2.85	100%

From the calculation results obtained 5 risks that have the highest deviation value, namely collision of tugboats with a value of 0.61 or 21%, changes in customer tastes with a value of 0.45 or 37%, engine failure on the ship with a value of 0.45 or 53%, Theft of various equipment on board with value 0.39 or 67% and the high price of fuel with a value 0.27 or 76%. Because value of the risk appetite of PT. X is 0.8 it means all of the 5 risks assessed do not need any mitigation plans and the company able to handle the risks due to the value less than 0.8

5. CONCLUSION

From the results of the calculation and risk assessment conducted, there are five risk results that have a high influence if it occurs at PT. X. There risks are: tugboat collisions with a value of 0.61, changes in customer tastes with a value of 0.45, engine failure on the ship with a value of 0.45 and Theft of various equipment on board with a value of 0.39, and high fuel price with a value of 0.27. Based on the calculation, there are 5 types of risks that have the highest deviation value and the value is almost close to the maximum risk value threshold of 0.8. Finally, PT. X requires to improve the effectiveness of BCP at each stage of the PDCA cycle supported by business continuity policies and objectives, audit results, analysis of monitored events, corrective actions, and management reviews

6. REFERENCES

Auliya Rahmayani, M. I. (2016). *Perancangan dan Implemaentasi Perangkat Kriteria*

Buda, K., & Dinariyana, A. B. (2013). *Teori keandalan sistem dan aplikasinya* (1st ed.). Surabaya: Guna Widya.

Gurning, R. O. (2011). *Maritime Disruption In The Australia Indonesia Wheat Supply Chain.* Australia.

ISO/IEC. (2009). *ISO Guide 73: Risk Management Vocabulary.* Switzerland: ISO/ICE.

IRM. (2002). *A Risk Management Standard.* London: The Institute of Risk Management.

Jafar, R., (2016). Best worst multi criteria decision making method: Some properties and a linear model. *Science Direct*, 64 (October 2016), 126-130.

Jafar, R. e., (2015). Best-worst multi-criteria decision-making method. *ScienceDirect*, 53 (June 2015), 49-57.

Khamehchi, E. K., (2016). A case Study to optimum selection method for gas condensate well design. *South Pars gas field, Ain Shams Engineering Journal*, 847-853.

Okuna, P. A. (2014). *Bussiness Countinuity Management System at Kenya Bereau of Standards.*

Rahardjo J., S. R,. (2000). Jurnal Teknik Industri . *Penerapan Multi Criteria Decision Making* , 1-12.

Sarwono, J. (2006). *Analisa data penelitian menggunakan SPSS.* Yogyakarta. Trihendari, C. (2013). *Step By Step IBM SPSS 21 Analisis Data Statistik.* Yogyakarta.

Torabi.A.Z., Giahi, R., Sahebjamnia, N., (2016). An enhanced risk assessment framework for business continuity management systems. *Safety Science*, 89 (Nopember 2016), 201-218.

Trihendari, C. (2013). *Step By Step IBM SPSS 21 Analisis Data Statistik.* Yogyakarta.

Zaman, B., Kobayashi, E.N., Wakabayashi, N., Khanfir, S., Pitana, T., Maimun A., (2014). Fuzzy FMEA model for riskevaluation of ship collosions in the Malllaca Strait: based on AIS data. *Journal of Simulation*, 8 (1), 91-104

Zhaoxu, S. a. (2010). multi Criteria Desicion Making BAsed on PROMETTHEE method. *International Conference on Computing, Control and Industrial Engineering*, 416-418.