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RISK ANALYSIS OF LANDING SHIP TANK WARSHIPS FOR DELIVERY OF LOGISTIC ASSISTANCE IN ISLANDED EARTHQUAKE LOCATION

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ABSTRACT

The future threat to the world, including Indonesia, is natural disasters. The Navy as a means of state defense places natural disaster management as a form of military operation task other than war. Landing Ship Tank (LST) type warship is a defense system capable of delivering logistics on a large scale directly to disaster locations via beaching. The main problem is still finding delays and failures in logistics delivery caused by equipment damage with the biggest loss being the sinking of warships. The aim of the research is to minimize the occurrence of risk events by making a risk management design based on the ISO 31000 framework which focuses on warship operations. The method used by the House of Risk (HOR) is divided into two stages. HOR stage 1 focuses on ranking the Aggregate Risk Potential (ARP) value with the help of a Pareto diagram to determine the selected risk agent, which then requires treatment on a priority scale. The results of the HOR stage 1 are then entered into the HOR stage 2 to obtain the most effective preventive action. The results obtained, there are 8 risk agents that need to be handled. Furthermore, based on brainstorming with the Expert (the commander of the warship) obtained 12 mitigation actions that can be implemented immediately.

Keywords: *Risk Analysis, Landing Ship Tank, HOR.*

1. INTRODUCTION

Indonesia is a country that is located between 3 tectonic plate meeting paths, which results in frequent earthquakes. The movement of the three plates causes the islands of Indonesia to experience earthquake vibrations from time to time, especially in the area where the plates meet, namely the meeting of the Eurasian plate and the Australian plate along the islands of Sumatra, Java, Bali, Nusa Tenggara, and the meeting of the Australian and Pacific plates in the island region. Papuans. This is because Indonesia is on the path of earth's tectonic and volcanic activity. Both of these activities are natural processes of the planet Earth which is always moving (Arie Priambodo, 2009).

Figure 1. Disaster Map in Indonesia

The Navy as an element of power at sea is required to be able to carry out its duties through strength building that is focused on the power structure through the Integrated Fleet Weapon System. These components are Republic of Indonesia ships, marines, aircraft and bases (Putra, 2016). The Navy has warships delivering troops on a large scale, especially in amphibious operations, namely landing ship tank (LST) types. In carrying out its main tasks related to amphibious operations, this type of warship is under the Amphibious Ship Unit. LST has the advantage that it is able to dock at the low tide line farthest from the target beach, so that it can carry out landings at coastal locations.

The current condition of the existing LST type warships is over 30 years old, namely the Frosch type LST, a former East German Navy ship made in 1977 and the Korean-made LST in 1980. Other problems are personnel limitations and the unpreparedness of the warship's technical condition which results in not achieving organizational goals. The use of alternative spare parts in overcoming the limitations of spare parts can cause disturbances and obstacles during operational implementation. The following are some of the risk events experienced by LST type warships that cause light to heavy losses.

2. MATERIALS AND METHODS

2. 1 Risk

Risk is defined as "the adverse impact on probability of several distinct sources of uncertainty". Risk is defined as the uncertainty caused by changes. Risk is a deviation from something expected (Joel Bessis, 2010). This uncertainty factor ultimately causes risk in an activity

2.2 Risk management

Risk Management is defined as a directed and coordinated organizational activity, which is related to the risks that exist in the organization. Risk management has several components consisting of principles, frameworks and processes. The risk management process is a series of risk management activities that deal with risks one by one and in groups according to the type of target affected. Thus, the risk management process is the core of the overall risk management (Kaho, 2018). The implementation of risk management in a company is very necessary, as the implementation guidelines have been set based on SN ISO 31000.

2.3 The Risk Management Process

The Risk Management Process is based on the ISO 31000 standard consists of systematic application of procedures, policies, and several approaches in the application of communication and consultation, building context and assessing risk, treatment, monitoring, reviewing, recording and reporting to interested parties. The risk management process must be an integral part of management and decision making, and integrated into the structure, operations and processes of the organization. Therefore, there are many process models for implementing risk management in organizations, specifically designed for the needs of achieving various organizational goals that are in line with the internal and external context of the organization, where the risk management process is carried out.

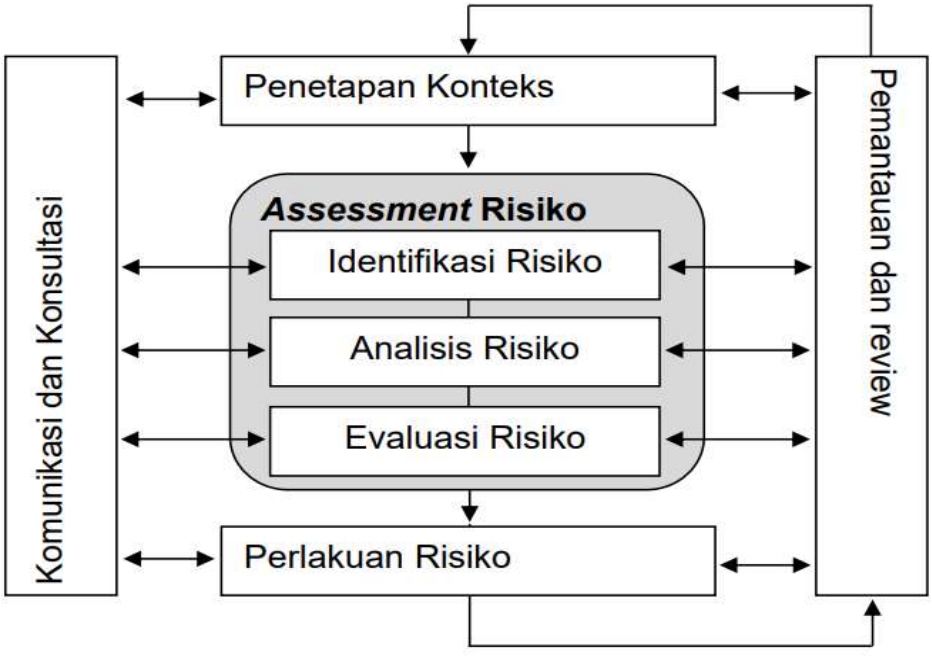

Figure 2. Risk-Based Assessment
ISO 31000

2.4 House of Risk.

House of Risk is a method based on the need for risk management that focuses on prevention activities in determining which risk causes are a priority and then mitigation or risk mitigation measures will be given (Pujawan,

2009). The following are the stages in compiling HOR stage 1:

a. Identify risk events that may occur in the company's business processes.

b. Calculate the severity value of each risk event and the occurrence value of each risk agent.

c. Build a relationship matrix between risk agents and risk events.

d. Calculate the aggregate risk potential value of the risk agent

e. Ranking the risk agents based on the ARP value.

Table 1. HOR Matrix 1

		Risk Agent (Aj)							Severity of risk event i (Si)
Business processes	**Risk event (Ei)**	**A_1**	**A_2**	**A_3**	**A_4**	**A_5**	**A_6**	**A_7**	
Plan	E_1	R_{11}	R_{12}	R_{13}					S_1
	E_2	R_{21}	R_{22}						S_2
Source	E_3	R_{31}							S_3
	E_4	R_{41}							S_4
Make	E_5								S_5
	E_6								S_6
Deliver	E_7								S_7
	E_8								S_8
Return	E_9								S_9
Occurrence of agent j		O_1	O_2	O_3	O_4	O_5	O_6	O_7	
Aggregate risk potential j		ARP_1	ARP_2	ARP_3	ARP_4	ARP_5	ARP_6	ARP_7	
Priority rank of agent j		P_1	P_2	P_3	P_4	P_5	P_6	P_7	

The following are the stages in compiling HOR stage 2:

a. Choose several risk agents with high priority, can use the Pareto chart.

b. Identify appropriate actions to prevent risk agents.

c. Determine the value of the relationship between each preventive action and each risk agent

d. Calculate the total effectiveness value of each preventive action

Table 2. HOR Matrix 2

	Preventive Action (PAk)					Aggregate risk potentials (ARPj)
To be treated risk agent (Aj)	**PA_1**	**PA_2**	**PA_3**	**PA_4**	**PA_5**	
A_1	E_{11}					ARP_1
A_2						ARP_2
A_3						ARP_3
A_4						ARP_4
Total effectiveness of action k	TE_1	TE_2	TE_3	TE_4	TE_5	
Degree of difficulty performing action k	D_1	D_2	D_3	D_4	D_5	
Effectiveness to difficulty ratio	ETD_1	ETD_2	ETD_3	ETD_4	ETD_5	
Rank of priority	R_1	R_2	R_3	R_4	R_5	

3.5 Landing Ship Tank

One of the supporting elements of the Fleet is the LST type WARSHIP under the Amphibious Unit (Satfib) of the Koarmada. The LST type WARSHIP has the main task of transporting logistical equipment (Ranpur,

Ranmor, Ranfib and Hellycopter) and combat troop personnel from the starting base to the target area (landing beach). In addition, it has additional duties, including:

a. Transporting helicopters for special tasks (Reconnaissance, Raid and SAR).
b. To transport personnel changing troops or shifting troops.
c. To transport logistical equipment in order to resupply troops in the area of operation.
d. Marine VIP transport support.

Figure 3. LST type warship

3 RESULT AND DISCUSSION.

3.1 Risk Management Design

The scope of the research is at the operational stage of warships with the object of research being LST warships. The operational phase includes 3 stages, namely: embarkation, sea crossing and debarkation. In designing risk management using the SNI ISO 31000 approach, which can be systematically divided into four main stages, including: determination of context, risk identification, analysis and evaluation as well as responses or reactions to overcome these risks. The House of Risk (HOR) method will be used at the stage of risk identification, risk analysis and risk evaluation.

3.2 Risk Identification

The risk identification process plays the most important role because from this process all existing or potential risks can be identified. Based on the Master Combat Book owned by the warship, brainstorming with experts was carried out to identify any risk events that might occur at each stage carried out.

3.3 Risk Event Identification

The determination of the results of the risk event identification after being validated by the expert was obtained as many as 9 risk events.

Table 3. Risk Event

Tahapan	Kejadian Risiko *(risk event)*	Kode
Embarkasi	Operasional KRI yang *over load*	E1
	Pengumpulan bantuan logistik tidak sesuai jadwal	E2
	Keterbatasan alokasi penyimpanan	E3
Lintas laut	Kecelakaan kapal	E4
	Kerusakan peralatan kapal	E5
	Kapal tenggelam	E6
	Kehilangan barang bantuan logistik	E7
Debarkasi	Lokasi tidak sesuai tujuan	E8
	Dermaga tidak ada	E9

3.4 Risk Agent Identification

The next step is to identify the risk agent. The risk agent is a factor that triggers the emergence of risk events so that by carrying out mitigation strategies against risk agents, they can avoid or reduce risk events that will occur. The determination of the results of the risk agent identification after being validated by the expert was obtained as many as 28 risk agents.

3.5 Measurement of Severity, Occurance and relationship

At this stage, measurements are carried out using a questionnaire to find the severity level), occurrence level and relationship level. The level used for measurement is five levels which are known as likelihood values. It aims to determine an adequate level for each impact and its likelihood of occurring. If you use too many levels, it will be difficult to choose the right level of impact and probability, especially between levels that are close to each other (Kaho, 2018).

Table 4. Severity scale

Tingkat	Dampak	Deskripsi
1	Tidak Signifikan	Dampak yang sangat kecil atau tidak penting atau sangat sedikit perlu perhatian atau bahkan tidak butuh perhatian
2	Kecil	Tidak terlalu penting atau bernilai, tidak terlalu serius, tidak menyebakan masalah atau kerusakan
3	Sedang	Cukup besar atau punya pengaruh untuk mendapat perhatian
4	Besar	Sangat buruk, serius atau kerusakan yang tidak dikehendaki
5	bencana	Dampak yang menggagalkan pencapaian sasaran

Table 5. Occurance scale

Tingkat	Probabilitas	Deskripsi
1	Sangat Kecil	Hampir tidak mungkin terjadi
2	Kecil	Kemungkinan kecil terjadi
3	Sedang	Kemungkinan terjadi dan tidak terjadi sama
4	Besar	Kemungkinan besar terjadi
5	Sangat besar	Hampir pasti terjadi

Meanwhile, to determine the value of the relationship between risk agents and risk events, the correlation value can be in the form of a scale {1, 3, 9} which describes the existence of a low, medium and strong relationship. This relationship is symbolized by (Ejk) which can be interpreted as the degree of effectiveness of action k against risk agents j.

Table 6. Relationship Scale

Tingkat	Deskripsi
9	Menunjukkan adanya hubungan korelasi yang kuat antara *risk agent* dengan *risk event*
3	Menunjukkan adanya hubungan korelasi yang sedang antara *risk agent* dengan *risk event*
1	Menunjukkan adanya hubungan korelasi yang lemah antara *risk agent* dengan *risk event*

3.6 HOR Operasional

Stage 1: Identification of Risk Priorities

Determination of which risk source to choose is based on the value of the Aggregate Risk Priority (ARP). Where the ARP value consists of three factors, namely occurrence, severity and relationship. The first step in HOR Stage 1 is to provide an assessment of the severity level with a value of 1-5 on the risk event and an assessment of the occurrence level with a value of 1-5 on the risk agent by an expert.

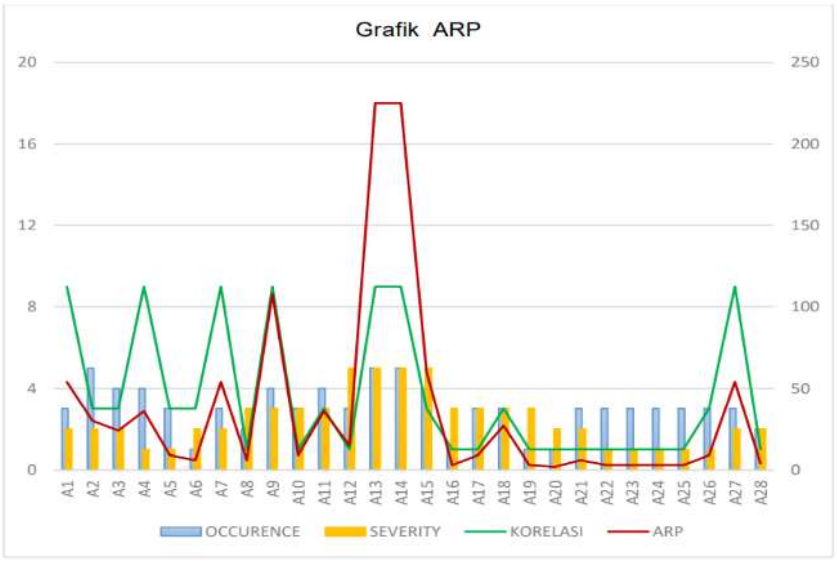

Figure 4. Chart of ARP

Based on the ARP graph, the main rankings are (A13) Limited ABK with special skills and (A14) Limited spare parts, then for the cumulative percentage up to 100%.

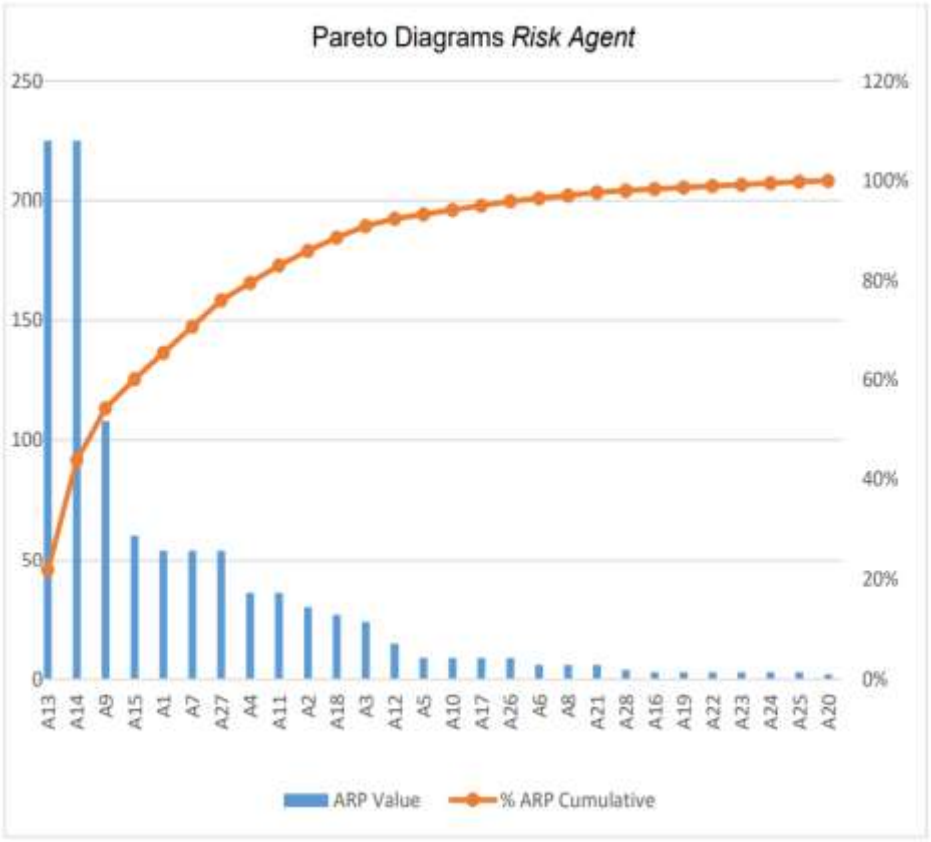

Figure 5. Pareto Chart

From the results of the ARP value, the priority of risk agents is classified from the overall risk that will be given handling actions in an effort to minimize the occurrence of risk using a Pareto diagram. With its form in the form of a bar chart, Pareto is useful for identifying the most common events or causes of problems. Pareto analysis is based on the 80/20 concept which means that 80% of losses are caused by only 20% of the biggest problems

Stage 2: Risk Management

In handling this risk by using the HOR Model stage 2, preventive actions will be prepared or what are also known as mitigation actions against risk agents. This mitigation action aims to reduce the impact of a risk agent

before the risk occurs. As a first step, it is necessary to identify what preventive actions can be taken to prevent and minimize risk agents. The results of the identification of preventive action are obtained from brainstorming with experts.

Furthermore, the measurement of the difficulty level of the implementation of each preventive action (PA) variable is carried out. The level of difficulty is measured using a Likert scale of 1 to 5.

The first calculation in the HOR stage 2 is the total effectiveness of proactive (TEk), which is calculated from the sum of the results of the multiplication of the correlation value between risk agents and mitigation actions with the ARP value obtained from the calculation of the HOR stage 1. This total effectiveness value is used to determine the effectiveness of the recommended precautions

Furthermore, the calculation of the ratio of total effectiveness to difficulty level (ETDk) aims to determine the priority ranking of all mitigation actions. The greater the value of the Dk level of difficulty, the smaller the ETDk value. This means that the mitigation action is less effective in reducing or mitigating the risk agent concerned, and vice versa.

After knowing the results of the ETDk value which is the output of the HOR phase 2, it can be ranked the sequence of mitigation actions.

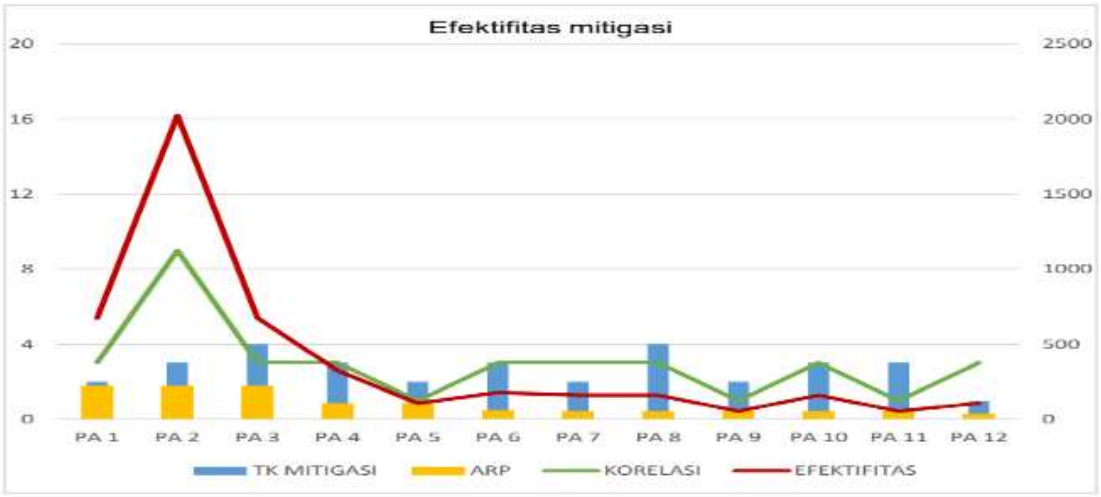

Figure 6. Mitigation Effectiveness

Figure 5 shows that (PA2) obtained the highest score as the top rank so that for the implementation of mitigation in LST operations the main priority is (PA2), namely carrying out the transfer of knowledge from senior to junior on an ongoing basis.

risk agent / risk event		Kapal dalam perbaikan	Tuntutan operasional tinggi	Penugasan kapal pada operasi lainnya	Pemberi bantuan kurang informasi	Sumber pemberi bantuan tidak terbatas	Perubahan bentuk bantuan	Kapasitas bantuan yang dikirim berlebih	Jalur pelayaran yang padat	Kelalian ABK	Kerusakan alat navigasi dan komunikasi	Cuaca buruk	ABK kurang terampil	Keterbatasan ABK dengan keahlian khusus	Keterbatasan suku cadang	SPT tidak terlaksana	Adanya kebocoran pada BGA kapal	Adanya ledakan pada ruangan yang rawan kebakaran	Alat penanggulangan kebocoran dan pemadam kebakaran terbatas	Kelebihan muatan	Barang bantuan terjatuh	Kerusakan barang akibat penyimpanan	Lokasi berlumpur	Lokasi banyak bebatuan	Arah angin berubah-ubah	Kecepatan arus tinggi	Informasi data kurang	Infrastruktur hancur	Adanya gempa bumi	***Saverity***
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	
Operasional KRI yang over load	E1	9	3	3																										2
Pengumpulan bantuan logistik tidak sesuai jadw al	E2				9	3																								1
Keterbatasan alokasi penyimpanan	E3						3	9																						2
Kecelakaan kapal	E4								1	9	1	3																		3
Kerusakan peralatan kapal	E5												1	9	9	3														5
Kapal tenggelam	E6																1	1	3	1										3
Kehilangan barang bantuan logistik	E7																				1	1								2
Lokasi tidak sesuai tujuan	E8																						1	1	1	1	3			1
Dermaga tidak ada	E9																											9	1	2
Occurance		3	5	4	4	3	1	3	2	4	3	4	3	5	5	4	1	3	3	1	1	3	3	3	3	3	3	3	2	
ARP value		54	30	24	36	9	6	54	6	108	9	36	15	225	225	60	3	9	27	3	2	6	3	3	3	3	9	54	4	
ARP rank		5	10	12	8	14	18	6	19	3	15	9	13	1	2	4	22	16	11	23	28	20	24	25	26	27	17	7	21	

Figure 7. Matrix HOR

preventive actionn / risk agent		Melaksanakan pelatihan dengan keahlian khusus	Melaksanakan transver ilmu dari senior ke junior secara berkelanjutan	Mencari alternatif suku cadang sesuai kebutuhan	Pembuatan daftar kerja saat mulai kegiatan	Pengecekan perwira KRI terhadap ABK secara berkala	Melaksanakan kembali SPT sesuai prosedur di KRI	Melaksanakan pemeliharaan organik KR secara berkala	Pemenuhan suku cadang onboard KRI	Pengiriman bantuan berdasarkan prioritas	Pelaksanaan beaching langsung di lokasi	Mencari alternatif lokasi beaching	Pembuatan posko dari media cetak maupun internet sebagai sumber informasi	*ARP value*
		PA1	**PA2**	**PA3**	**PA4**	**PA5**	**PA6**	**PA7**	**PA8**	**PA9**	**PA10**	**PA11**	**PA12**	
Keterbatasan ABK dengan keahlian khusus	**A13**	3	9											225
Keterbatasan suku cadang	**A14**			3										225
Kelalian ABK	**A9**				3	1								108
SPT tidak terlaksana	**A15**						3							60
Kapal dalam perbaikan	**A1**							3	3					54
Kapasitas bantuan yang dikirim berlebih	**A7**									1				54
Infrastruktur hancur	**A27**										3	1		54
Pemberi bantuan kurang informasi	**A4**												3	36
TEj		675	2025	675	324	108	180	162	162	54	162	54	108	
Degree of Difficulty (Dk)		2	3	4	3	2	3	2	4	2	3	3	1	
Effectiveness to Difficulty (ETD)		337.5	675.0	168.8	108.0	54.0	60.0	81.0	40.5	27.0	54.0	18.0	108.0	
Rank of Priority		2	1	3	4	8	7	6	10	11	9	12	5	

Figure 8. Matrix HOR 2

4 CONCLUSIONS

Based on a series of data processing, scenario preparation and analysis of research results, some conclusions can be drawn as follows

a. Based on the results of risk event identification in the operation of the LST type WARSHIP, there were 9 risk events, including 3 at the embarkation stage, 4 at the sea crossing stage, and 2 at the debarkation stage. Furthermore, from the results of the identification of risk agents, 28 risk agents were obtained with the level of occurrence and the correlation value of each of the risk events that will be processed in the House of Risk stage 1.

b. The results of the House of Risk model stage 1 are processed using a Pareto diagram, it is found that 8 risk agents are selected according to the top ranking. Then processed using the House of Risk model stage 2, there are 12 mitigation actions (preventive actions) which are then calculated for the difficulty level effectiveness value (ETD). The results of the ETD calculation are obtained according to the top ranking, namely: (PA2) Carrying out knowledge transfer from seniors to juniors on an ongoing basis, (PA1) Carrying out training with special skills, (PA3) Looking for alternative spare parts as needed, (PA4) Making work lists when starting activities , (PA12) Making command posts from print media and the internet as a source of information, (PA7) Carrying out regular organic maintenance of WARSHIP, (PA6) Re-implementing SPT according to procedures in WARSHIP, (PA5) Checking WARSHIP 88 officers on crew members periodically, (PA10) Implementation of direct beaching on site, (PA8) Fulfillment of WARSHIP onboard spare parts, (PA9) Delivery of assistance based on priority, (PA11) Looking for alternative beaching locations.

c. Risk handling and risk control in the Landing Ship Tank type WARSHIP is to provide each recommended action for each mitigation action that has been selected for immediate risk management.

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REFERENCES

Alijoyo, A. (2006). *Enterprise Risk Management.* Jakarta: PT. Ray Indonesia.

Ahmad, dkk (2020) *Mitigation of Supply Chain Risk using HOR Model at* PT. Sumber Karya Indah doi:10.1088/1757-899X/847/1/012059

Ardhiwirawan, D. S. (2018). Analisis Pelaksanaan Manajemen Risiko dengan Aplikasi Enterprise Risk Management Pada PT Bukit Asam Tbk

BNPB. (2017). Data Bencana Indonesia : Pusat Data, Informasi dan Humas Badan Nasional Penanggulangan Bencana.

COSO, T. C. (2017). *Enterprise Risk Management*. New Jersey

Devi, R. S. (2016). Analisa Risiko Operasional PT.XYZ.

Fahmi I. (2010). Managemen Risiko (Teori, Kasus dan Solusi). Bandung: Alfabeta.

Gibson, D. I. (1997). Efektifitas Organisasi Dan Manajemen. Wienna: Erlangga Jakarta.

ISO. (2018). ISO 31000: 2018, *Risk Management-Guidelines*. Genever: ISO

Joko Christanto. (2011).Gempa Bumi, Kerusakan Lingkungan, Kebijakan dan Strategi Pengelolaan.Yogyakarta: Liberty

Kaho, L. J. (2018). Manajemen Risiko Berbasis ISO 31000: 2018, Panduan Untuk *Risk Leaders* Dan *Risk Practitioners*. Jakarta: PT. Gramedia Widiasarana Indonesia.

Kountur, R. (2004). Manajemen Risiko Operasional, Memahami Cara Mengelola Risiko Operasional Perusahaan. Jakarta : Penerbit PPM.

Kusnadi, C. (2014). Pengelolaan Risiko Pada *Supply Chain* Dengan Menggunakan Metode *House Of Risk* (Studi Kasus di PT . XYZ).

Kurniasari, D. (2010). Aplikasi Model *House of Risk* (HOR) untuk mitigasi risiko proyek pembangunan jalan tol Gempol-Pasuruan. Prosiding Seminar Nasional Manajemen Teknologi XI, Program Studi MMT-Institut Teknologi Sepuluh Nopember

Normaria M. Sirait, A. S. (2015). Analisa Risiko Operasional Berdasarkan Pendekatan *Enterprise Risk Management* (ERM) Pada Perusahaan Pembuatan Kardus di CV Mitra Dunia Palletindo

Notoatmodjo, S. (2003). Pengembangan Sumber Daya Manusia (5 ed.). Jakarta: PT Rineka Cipta.

Pujawan, I. N., & Geraldin, L. H. (2009). *House of risk: a model for proactive supply chain risk management*. *Emerald: Business Process Management Journal* , Vol. 15 No. 6, pp. 953-967

Putri Amelia, I. V. (2017). Analisa Risiko Operasional Pada Divisi Kapal Perang PT. PAL Indonesia dengan Metode *House Of Risk*.

Putra, I N (2016). Konsepsi Pembangunan Kekuatan dan kemampuan Teknologi Informasi TNI AL dalam mendukung Penyelenggaraan Strategi Pertahanan Laut Nusantara. Malang : Bintang Surabaya.

Setia Mulyawan, (2015). Manajemen Risiko. Bandung : Pustaka Setia.

Siegel, J. G., & Sim, J. K. (1999). *Operations Management.* Hauppauge, NY: Barron's *Business Review.*

Silvana Maulidah, (2020) *Risk Mitigation of Tobacco Supply Chain: Business Process Model* DOI: 10.21776/ub.habitat.2020.031.3.18

Soehatman Ramli, (2010). Manajemen Bencana, Pedoman Praktis (*Disaster Management*). Jakarta :PT Dian Rakyat.

Sondang, S. P. (1998). *Manajemen Strategi* (3 ed.). Jakarta: Bumi Aksara.

Soehatman Ramli, (2010). Manajemen Risiko, Pedoman Praktis dalam Perspektif K3 OHS Risk Management. Jakarta :PT Dian Rakyat

Sutanto, S. (2012). Desain *Enterprise Risk Management* Berbasis ISO 31000 Bagi Duta Minimarker di Situbondo..