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Risk Management in the Implementation of the Occupational Safety and Health System (SMK3) in the PLN Maluku and Papua Substation Project

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ABSTRACT

Keywords: risk management, occupational safety and health, SMK3, PLN substation, Maluku Papua.

This research involves several PLN substation projects in the Maluku and Papua regions. The subject of this study consisted of 25 respondents, namely 1 Project Manager, HSE Engineer and project supervisor. The questionnaire that has been given is then analyzed using the severity index method. The results of K3 risk identification on 44 risk variable indicators with high variables are found in the categories of product purchase and control, work safety in SMK3 and monitoring standards. The highest level of K3 risk to cost performance in substation construction projects in Maluku and Papua is the specification of the purchase of goods and services, the verification system of purchased goods and services, emergency planning and recovery, and labour health monitoring. The allocation of K3 risk in substation construction projects in Maluku and Papua is the most allocated risk shared between the owner and the contractor. The most K3 risk response is by holding and partially allocating to the owner by transferring. Recommendations for mitigation of K3 risks in substation construction projects in Maluku and Papua are by preparing procedures for work steps/related documents that are jointly supervised between the owner and owner. Then it is necessary to form an organization related to K3 that will be responsible for emergencies, work accidents and monthly reporting to the local Manpower Office.

Introduction

The development of electricity construction projects in Indonesia, namely the 35,000 MW power plant construction program, is one of the government's mega projects to provide electricity to the community (Fitriana & Wahyuningsih, 2017). During the construction process to complete the construction within the agreed time according to the contract, many works have the potential to cause work accidents (Pangkey, Malingkas, & Walangitan, 2012).

Maluku and Papua is the easternmost province of Indonesia which is a project area carried out by PT PLN (Persero) Maluku and Papua Development Main Unit (UIP). PT PLN (Persero) UIP MPA handles power plant, substation and transmission construction projects. Several substation construction projects are in the construction stage that are being worked on in Maluku and Papua (Maftuchan, 2018). The level of K3 risk in electrical projects such as substations is extreme and high, so it requires a risk analysis of the Occupational Safety and Health Management System (SMK3) in the field (Yuliana, 2021).

SMK3 is an inseparable part of the labour protection system and construction services work can minimize and avoid the risk of moral and material losses, loss of working hours, as well as the safety of humans and the surrounding environment which can later support effective and efficient performance improvement in the development process (Kristiana & Wijayanto, 2017).

The implementation of SMK3 can be a reference that regulates various activities in it and manages K3 systematically and comprehensively in a complete management system so that it is expected to minimize the risk of work accidents that will occur starting from the highest level to the lowest level of work accidents (Albani Musyafa, 2020). The implementation of K3 by procedures will foster trust and confidence in the safety and security guarantees of construction service users (Nurdin, 2022).

According to data on work accidents for the construction of PT PLN (Persero) construction projects in 2021-2022 No.40438/KLH.01.01/D0150500/2022, there were 26 work accidents, one of which was caused by being hit by the rubble of coal blocks during power generation work (Abisono, 2024). Various obstacles encountered in the implementation of SMK3 are a lack of knowledge about regulations related to SMK3 and the competence of personnel in the field in implementing SMK3 in the substation construction project (ADHIEM, PERMANA, & FATURAHMAN, 2021).

Previous research "Project Risk Analysis with the Analytical Hierarchy Process (AHP) Method (Case Study: Lampung Modern Library Project at Advanced Stage)"

Risk events can be studied in the form of fishbone diagrams and analyzed using the Analytical Hierarchy Process (AHP) method. The AHP method will provide a significant risk priority order to the project cost. This study was conducted based on a questionnaire to determine the frequency of risks and the impact of risks.

The results of the study showed a high-risk rating based on the risk factor value (FR). The risk with the highest risk factor is an addendum with FR = 0.5574 which is categorized as a moderate level risk. Meanwhile, the risk with another medium-level category is the risk of design changes with FR = 0.4695, and the low level is damage to the main facilities by a third party with Risk Factor FR = 0.1459.

The handling of addendum risks is by accelerating the administrative process of submitting addendums so that there are no delays in work. Meanwhile, the risk of design changes is handled by re-coordinating between contractors and consultants to make design changes.

The objectives of this study are:

1. Identifying risks that occur in SMK3 of the PLN Maluku and Papua substation projects
2. Determining the high risk affecting SMK3 in PLN's substation project in the Maluku and Papua regions
3. Determining the allocation and risk response that affects SMK 3 of the PLN substation project in the Maluku and Papua regions
4. Determining risk mitigation recommendations at SMK3 of the PLN substation project in the Maluku and Papua regions

Research Methods

Research Location

The research location was carried out in several provinces, namely Maluku, North Maluku, Papua and West Papua.

Data Source

Data analysis was carried out based on data obtained from in-depth interviews with informants and then compared with the theory in the literature review. Furthermore, the collected data will be processed and presented narratively in the form of a matrix table according to the variables studied.

Data Primer

This primary data includes;

1. Interview

According to (Moleong, 2019) explained that an interview is a conversation with a specific intention. The conversation was carried out by two parties, namely the interviewer who asked the question and the interviewee who answered the question.

2. Observation

According to (Noor, 2011), observation is divided into participant observation, overt and covert observation, and unstructured observation.

Data about informants

Data on informants were obtained from exclusive interviews and the distribution of questionnaires to workers and experts.

Data Seconds

In this study, the secondary source of data is the Cost Budget Plan (RAB), schedule, books, journals, and articles related to research topics regarding the internal control system over payroll systems and procedures to support labour cost efficiency.

Data Collection Method

The methods used in the research are qualitative and quantitative methods, conducting interviews and distributing questionnaires, where questionnaires are prepared based on previous research studies. related to the problem being studied.

The questionnaire was distributed to the respondents by being delivered directly by the researcher, to ask the respondents to fill out the questionnaire. If the respondents are busy enough, then the researcher leaves the questionnaire, then asks to be filled out directly by the Consultant/Worker who directly works on the project and will be taken after a few days.

Results and Discussion

Risk Variable Analysis

The process of risk variable analysis to analyze the data in this study was carried out on the assessment of probability and risk impact on cost and time aspects in the construction project of Avalanche Bridge 1 and 2. This analysis uses the Severity Index (SI) method. Where SI has the advantage of making it easier to classify.

Risk Probability Assessment Against Cost Performance

The scale of probability and impact assessment according to (Majid and McCaffer, 1997) is as follows:

Very rare/low (SJ/SR) = 0,00 < SI ≤12,5
Rare/Low (J/R) = 12,5 < SI ≤ 37,5
Moderate/Medium (C/S) = 37,5 < SI ≤62,5
Frequently/High (S/T) = 62,5 < SI ≤ 87,5
Very Frequently/High (SS/ST) = 87,5 < SI ≤ 100

$$SI = \frac{\sum_{i=0}^{4} ai.xi}{4\sum_{i=0}^{4} xi}(100\%) \quad \ldots\ldots \quad 2$$

$$SI = \frac{\{(0x6) + (1x6) + (2x4) + (3x7) + (4x2)\}}{4x25}$$

SI = 43%

where

AI = Rating Constant

xi = frequency of respondents

i = 0, 1, 2, 3, 4, ..., n

x0, x1, x2, x3, x4, is the respondent's frequency response

a0 = 0, a1 = 1, a2 = 2, a3 = 3, a4 = 4

x0= the frequency of respondents is "very low", then a0 =0

x1 = "low" respondent frequency, then a1 = 1

x2 = frequency of respondents "quite high", then a2 = 2

x3= "high" respondent frequency, then a3 = 3

x4= frequency of respondents "very high", then a4 = 4

The severity index value is 43%, so the probability category of the risk variable of the bottom soil condition is Medium (S).

Risk Impact Assessment on Cost Performance

The criteria for determining the scale of impact on costs were carried out according to Knight and Fayek in 2002, with the scale of impact on costs:

Very Low (SR) = 1 % ≤ Cost Overruns < 1,5 %

Low (R) = 1,5 % ≤ Cost Overruns < 2,5 %
Keep (S) = 2,5 % ≤ Cost Overruns < 3,5 %
Tall (T) = 3,5 % ≤ Cost Overruns < 4,5 %
Very High (ST) = 4,5 % ≤ Cost Overruns < 5 %

Risk Probability Assessment of Time Performance

Based on the data analysis in Table 4.4 on probability assessment using the severity index method, the SI results with a high category (T) were obtained in the data risk variables and K3 reports around an SI value of 64.00%.

Risk Impact Assessment on Time Performance

The criteria for determining the scale of impact on time are based on Kerzer 2006, the description of the scale of impact on time is as follows:
Very Low (SR) = Not affected by the project *schedule* ≤ 1 day
Low (R) = There is a delay in the project *schedule* >1-3 days
Medium (S) = There is a delay in the project *schedule* > 3-7 days
High (B) = There is a delay in the project *schedule* > 7-30 days
Very High (ST) = There is a delay in the project *schedule* > 30 days

Determining the Risk Level

The determination of the performance risk scale in this study is based on PMBOK 2014, as a probability scale of respondents' assessment of the implementation of work. With the categorization of risk levels ranging from low (R), medium (S), and high (T), the risk level of cost performance can be seen in Table 4.7 as follows:

Table 1
Risk Level Matrix

probabilitas					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5

Dampak

SKOR	RISIKO
1-6	Rendah
7-10	Sedang
11-25	Tinggi

Sumber: PMBOK *guide*, 2014, dalam Rusim 2018

This analysis is applied to assess the risk level of cost and time performance. An example of calculating the level of risk of cost performance using the probability and impact multiplication method is as follows:

For example, the probability in the risk variable of emergency plan and recovery is obtained with a probability of 4 and an impact value of 3, then the value of the performance risk level is:

Risk Level = Probability x Impact

= 4 x 3 =12

From the results of the calculation of the risk level, it is then grouped according to the category, so that the performance risk level value of 12 is included in the "High" category.

Table 2
Risk Variable Categories on Cost Performance and Waktu

Kriteria	**interval**				**variabel biaya**	**variabel waktu**
Rendah	1	X	6	1 < X ≤ 6	2	21
Sedang	7	X	10	7 < X ≤ 10	38	19
Tinggi	11	X	25	11 < X ≤ 25	4	4
Total					**44**	**44**

Validation of Risk Results Against Time Performance

Table 3
Risk Outcomes on Time Performance

NO	VARIABEL RISIKO PENERAPAN SMK3	D (Dampak)	P (Probabilitas)	Risiko Kinerja Waktu	Level Risiko
	PEMBANGUNAN DAN PEMELIHARAAN KOMITMEN				
RF1	Kebijakan K3	2	2	4	Rendah
RF2	Tanggung Jawab dan Wewenang Untuk Bertindak	3	3	9	Sedang
RF3	Tinjauan Ulang dan Evaluasi	2	3	6	Rendah
RF4	Keterlibatan dan Konsultasi dengan Tenaga Kerja	3	3	9	Sedang
	PEMBUATAN DAN PENDOKUMENTASIAN RENCANA K3				
R5	Rencana strategi K3	2	2	4	Rendah
R6	Manual SMK3	2	3	6	Rendah
R7	Peraturan perundangan dan persyaratan lain dibidang K3	2	2	4	Rendah
R8	Informasi K3	2	3	6	Rendah
	PENGENDALIAN PERANCANGAN DAN PENINJAUAN KONTRAK				
R9	Pengendalian Perancangan	2	3	6	Rendah
R10	Peninjauan Kontrak	2	2	4	Rendah
	PENGENDALIAN DOKUMEN				
R11	Persetujuan,Pengeluaran dan Pengendalian Dokumen	2	3	6	Rendah
R12	Perubahan dan Modifikasi Dokumen	2	3	6	Rendah
	PEMBELIAN DAN PENGENDALIAN PRODUK				
R13	Spesifikasi Pembelian Barang dan Jasa	3	3	9	Sedang
R14	Sistem Verifikasi Barang dan Jasa Yang Telah Dibeli	4	3	12	Tinggi
R15	Pengendalian Barang dan Jasa Yang Dipasok Pelanggan	3	3	9	Sedang
R16	Kemampuan Telusur Produk	3	2	6	Rendah
	KEAMANAN BEKERJA BERDASARKAN SMK3				
R17	Sistem Kerja	3	3	9	Sedang
R18	Pengawasan	3	3	9	Sedang
R19	Seleksi dan Penempatan Personil	3	3	9	Sedang
R20	Area Terbatas	2	3	6	Rendah
R21	Pemeliharaan, Perbaikan, dan Perubahan Sarana Produksi	3	3	9	Sedang
R22	Pelayanan	2	3	6	Rendah
R23	Kesiapan Untuk Menangani Keadaan Darurat	3	3	9	Sedang
R24	Pertolongan Pertama Pada Kecelakaan	3	3	9	Sedang
R25	Rencana dan Pemulihan Keadaan Darurat	3	3	9	Sedang
	STANDAR PEMANTAUAN				
R26	Pemeriksaan Bahaya	3	3	9	Sedang
R27	Pemantauan/Pengukuran Lingkungan Kerja	3	3	9	Sedang
R28	Peralatan Pemeriksaan/Inspeksi, Pengukuran dan Pengujian	3	3	9	Sedang
R29	Pemantauan Kesehatan Tenaga Kerja	3	2	6	Rendah
	PELAPORAN DAN PERBAIKAN KEKURANGAN				
R30	Pelaporan Bahaya	4	3	12	Tinggi
R31	Pelaporan Kecelakaan	3	3	9	Sedang
R32	Pemeriksaan dan pengkajian Kecelakaan	4	3	12	Tinggi
R33	Penanganan Masalah	4	3	12	Tinggi

Risk Mitigation Recommendations

There are 7 risk variables contained in cost performance risk and time performance risk using direct interviews with respondents from each project, mitigation is handled as follows:

Table 4

No.	Risk Variables	Risk Mitigation
1	Specifications for Purchase of Goods and Services	- Monitoring the preparation of procurement plan documents with the procurement team- Supervising the procurement process, both direct appointments/open tenders
2	Verification System for Goods and Services Purchased	Check the goods/materials that have arrived at the project site with the owner and contractor before payment is made
3	Emergency Planning and Recovery	Prepare an emergency response plan Conduct emergency response simulations together with stakeholders
4	Workforce Health Monitoring	Prepare employee health screening procedures for health workers at the project site who can periodically check the health of workers before activities such as in high-altitude areas
5	Hazard Reporting	Conduct routine inspections at the project site with K3 supervisors
6	Accident inspection and assessment	Prepare work accident procedures along with minutes in the event of a work accident and establish an investigation team when a work accident occurs
7	Problem Handling	Establish an OSH team organization in each project and a monthly OSH report to monitor the OSH workforce and activities and the risks of each work in the project on IBPPR

Risk Level Recapitulation

Table 5
Risk Scale to Cost Performance

NO	VARIABEL RISIKO PENERAPAN SMK3	D (Dampak)	P (Probabilitas)	Risiko Kinerja Biaya	Level Risiko
R13	Spesifikasi Pembelian Barang dan Jasa	4	3	12	Tinggi
R14	Sistem Verifikasi Barang dan Jasa Yang Telah Dibeli	4	3	12	Tinggi
R25	Rencana dan Pemulihan Keadaan Darurat	4	3	12	Tinggi
R29	Pemantauan Kesehatan Tenaga Kerja	4	3	12	Tinggi

Table 6
Risk Scale Against Time Performance

NO	VARIABEL RISIKO PENERAPAN SMK3	D (Dampak)	P (Probabilitas)	Risiko Kinerja Waktu	Level Risiko
R14	Sistem Verifikasi Barang dan Jasa Yang Telah Dibeli	4	3	12	Tinggi
R30	Pelaporan Bahaya	4	3	12	Tinggi
R32	Pemeriksaan dan pengkajian Kecelakaan	4	3	12	Tinggi
R33	Penanganan Masalah	4	3	12	Tinggi

Conclusion

Based on the results of the analysis and discussion, it can be concluded that what can be taken from this study is as follows. The results of K3 risk identification of 44 risk variables showed that high variable indicators were found in the categories of product purchase and control, work safety in SMK3, and monitoring standards. The highest level of K3 risk to cost performance in substation construction projects in Maluku and Papua is the specification of the purchase of goods and services, the verification system of purchased goods and services, emergency planning and recovery, and labour health monitoring.

Furthermore, the highest level of K3 risk-to-time performance in substation construction projects in Maluku and Papua is the system of verification of purchased goods and services, hazard reporting, accident inspection and assessment, and problem handling. The allocation of K3 risk in substation construction projects in Maluku and Papua is most allocated between owners and contractors. The most K3 risk response is by holding and partly allocated to the owner by transfer.

The recommendation for K3 risk mitigation in substation construction projects in Maluku and Papua is to prepare work procedures or related documents that are jointly supervised between the owner and the contractor. In addition, it is necessary to form an organization related to K3 that will be responsible for emergencies, work accidents, and monthly reporting to the local Manpower Office.

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