

# Accident Prevention Program Prioritization Using Kepner Tregoe Model: Case Study of PT Pertamina EP Regional 2 Zone 7

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## ABSTRACT

Pertamina EP Regional 2 Zone 7 (PEP R2Z7), a section of PT Pertamina EP (PT PEP), the National Oil Company of Indonesia, is an upstream Oil and Gas Company that operates in West Java Indonesia. The company conducts high-risk activities in exploration and production to extract oil and gas. According to the accident historical data, 40 work-related accident cases occurred in PEP R2Z7 in the period from 2018 to 2021. Accidents are caused by multiple factors that require programs to prevent a similar accident. The established accident prevention program in the company is generated from all accident data in PT PEP working areas around Indonesia which consist of 14 Zone. Because of these conditions, the accident prevention program becomes out of focus and needs to be prioritized based on accident case data. Accident prevention program priority is determined by the combination of Kepner Tregoe Method and Pertamina DNV SCAT accident root cause. The combination method is used to describe the root cause of an accident case, identify the accident prevention program criteria, and relevant alternatives to accident prevention programs based on the accident historical data, and choose the alternatives. The alternative solution is consist of the enhancement of established prevention programs and proposed the new prevention program. Some of Established prevention programs are still relevant with the historical data in Pertamina Region 2 Zone 7 such as Iman Campaign or Strengthen Work in Progress (WIP) Assessment. Meanwhile, some of the new proposed programs are Task Observation/Safety Awareness Supervision or Buddy System work for high-risk job. The implementation of the alternative solution is embedded in the Objectives Target Program (OTP) of Health Safety Security and Environment (HSSE) PEP R2Z7. The OTP contains the program purpose, detail program, the output and the evidence of the program, schedule, and progress monitoring of the program. The proposed alternative solution is expected to reduce the number of accident cases in PEP R2Z7.

**Keywords:** Accident Historical Data, Kepner Tregoe, Pertamina DNV SCAT, Priority.

## I. INTRODUCTION

According to the accident historical data in the period from 2018 until 2021, there are 47 accident cases that occurred in PEP R2Z7. The cases are divided into 40 Work Related Accident (WRA) and 7 Non Work Related Accident (NWRA). Work related case is an accident that occurs in a working area, related to the work process, and does not meet the 8 criteria of Occupational Safety and Health Administration (OSHA) log 300. In this period, accident case tends to raise as served in Table I.

TABLE I: THE TREND OF ACCIDENT CASE IN PEP R2Z7

Year	WRA	NWRA	Total Case
2018	9	0	9
2019	9	0	9
2020	11	1	12
2021	11	6	17

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During the period from 2018 to 2021, the top five accident types are First Aid Incident (11 cases), Property Damage (10 cases), Nearmiss (7 cases), Medical Treatment Incident (6 cases) and Environment Damage (4 cases). One accident case can be involved one or more accident types.

In the incident investigation process, PEP R2Z7 uses tool to collect information and detailed data related to the accident. The tool is adopted from the Det Norske Veritas - Systematic Cause Analysis Technique (DNV- SCAT) and named as Pertamina DNV SCAT tool.

Furthermore, the data is analyzed to get the dominant root cause and design the accident prevention programs. Since every accident occurs caused by multiple causes and the data generated from all PT PEP working areas, the accident prevention program becomes out of focus. Some program is not relevant to the operation condition in PEP R2Z7 and all program are handled equally regardless of the accident root cause data trend. For this reason, the accident prevention program is need to be arranged based on priority and designed

based on the accident historical data in PEP R2Z7.

Accident prevention is a major program of PEP R2Z7 to achieve zero accident cases as the company's main target and performance indicator. The program also aimed to ensure company business sustainability and prevent losses from the accident case.

## II. LITERATURE REVIEW

### A. Company Procedure

PEP R2Z7 categorized accidents as Safety, Health, Environment, or Security accident. Safety accident related to Occupational Safety and Process Safety. Health accident related to Occupational Health and Industrial Hygiene. The Environmental accident is caused by the spill of hydrocarbon, chemical, wastewater, or the condition of an environmental parameter beyond the government or company standard compliance. Security is caused by the danger to assets, environment, and business processes related to the sense of security.

### B. Pertamina DNV SCAT

Pertamina DNV SCAT determines the root cause of accidents and lessons learned from the accidents of human injury, environmental damage, property damage or security issue. SCAT was developed by Det Norske Veritas based on the loss causation model where the accident occurs as similar basic causes and the accident losses cause mainly by management system failure.

### C. Resource-Based View

Resources Based View Analysis is the systematic analysis to determine the types of resources or assets as the key to superior performance compared to competitors. (Frank T. Rothaermel, 2021). Resources based view is needed to get an overview of company resources to create the Sustainability Competitive Advantage (SCA). Sustainability Competitive Advantage is a business strategy that aimed to achieve and sustain a superior position over the competitor by offering a unique value proposition to the customer.

### D. OSHA Log 300

OSHA Log 300 is a tool developed by Occupational Safety and Health Administration and used by Pertamina to record the accident related to the reportable incident or illness in the workplace, the nature of the accident, the injured person, and the number of days away from work. According to OSHA, work-related injuries or illnesses are categorised as work-related if the case is caused by the event or exposure or significantly aggravated hazard in the work environment.

### E. Kepner Tregoe

Kepner Tregoe Decision Making founded by Kepner and Tregoe in 1981 is a systematic tool to solve problems and decision making by the process of identifying the concern, cause-effect, decision choice, and preparing the future problem. Kepner Tregoe problem solving and decision-making model consists of situation appraisal, problem analysis, decision analysis, and potential problem analysis.

## III. METHODOLOGY

The research scope is limited to Top Five Repeated Reportable Accident Case, Work Related Accident, and Occupational Illness Accident. Historical data analysis is based on the accident case occurs during the period from 01 January 2018 until 31 December 2021. This research was conducted in PEP R2Z7 working areas that consist of Bekasi, Kerawang, Subang, Indramayu, Majalengka and Cirebon.

The research uses a mixed method of quantitative and qualitative data. Quantitative data is collected by survey method meanwhile the qualitative data is collected by Forum Group Discussion (FGD) with HSSE Expert. Survey method was conducted by collecting questionnaire responses from employees of PEP R2Z7 with 186 total respondents. The total respondents consist of 60% (111 responses) Pertamina employees 32% (59 responses) Employee Outsourcing and 8% (16 responses) Contractors Employee. The FGD is conducted on March, 23<sup>rd</sup> 2022, with a meeting duration of about 180 minutes involving HSSE Manager, Safety Assistant Manager and HSSE Superintendent. The data quantitative and qualitative analyzed by the combination of Pertamina-DNV SCAT with Kepner Tregoe.

## IV. RESULT AND DISCUSSION

### A. Pertamina DNV SCAT Root Cause Analysis

Pertamina DNV SCAT record the detail and the root cause of the accident data. The data record consist of general information, accident root cause analysis, and consequences of the accident. The accident's root cause is divided into personal factors and job factors.

The priority of the root cause to be solved is determined by the number of relative percentage (RP). The relative percentage is calculated by dividing the frequency of each type of root cause by the total number of root causes in the period from 2018 until 2021. The relative percentage of personal factors (PF) is served in Table II and job factors (JF) is served in Table III.

TABLE II: RELATIVE PERCENTAGE OF PF IN PERIOD 2018–2021

PF	Frequency	RP
Lack of Knowledge	16	38.10%
Improper motivation	11	26.19%
Goal conflicts	8	19.05%
Lack of Skill	6	14.29%
Psychological Stress	1	2.38%
Total	42	100%

TABLE III: RELATIVE PERCENTAGE OF JF IN PERIOD 2018–2021

PF	Frequency	RP
Inadequate Communication	12	15.79%
Inadequate Supervision	12	15.79%
Inadequate Inspection	11	14.47%
Inadequate Work Standards	11	14.47%
Inadequate Equipment	9	11.84%
Inadequate Engineering	6	7.89%
Inadequate Changes	4	5.26%
Unclear Command Structure	4	5.26%
Excessive Wear	4	5.26%
Inadequate Purchasing	2	2.63%
Inadequate Purchasing	1	1.32%
Total	76	100%

The relative percentage is calculated to select focus on the dominant root cause and give a quick overview of the target of the accident prevention program. The result will be discussed in FGD to decide the acceptable risk by choosing the level of root causes that need to be solved and arrange the program for it.

### B. Kepner Tregoe (KT) Situation Analysis

KT Situation Analysis will be used to decide which problem receives the highest priority by using the criteria of timing, trend and impact. KT Situation Analysis criteria of timing, trend and impact evaluated by the degree of concern High (H), Medium (M) and Low (L). The Timing criteria consider the urgency of the problem, timeline or deadline, and what will happen if no action is done. The Trend criteria consider if the problem is getting worse and the growth of the problem. The Impact criteria consider the effect on the organization and how serious the problem.

The accident prevention program focuses on the high-risk job resulting from the probability multiple by the severity. Based on the Pertamina Procedure about Risk Management, the probability and severity, the limit of probability of unacceptable are minimum of one case in one year period. For this reason, the situation analysis will exclude the root cause that appears less than this limit. In the combination with the analysis in section IV. Above the relative percentage the accident root cause below 5% will be excluded from the KT Situation Analysis. The accident root cause situation analysis is served in Table IV.

TABLE IV: ACCIDENT ROOT CAUSE SITUATION ANALYSIS

Root Cause	Type	Timing	Trend	Impact
Lack of Knowledge	PF	M	M	H
Improper motivation	PF	H	H	H
Goal conflicts	PF	H	M	M
Lack of Skill	PF	L	L	M
Inadequate Communication	JF	H	M	H
Inadequate Supervision	JF	M	L	M
Inadequate Inspection	JF	H	H	H
Inadequate Work Standards	JF	M	L	M
Inadequate Equipment	JF	M	L	M
Inadequate Engineering	JF	M	L	M
Inadequate Changes	JF	L	M	L
Unclear Command Structure	JF	M	L	L
Excessive Wear	JF	L	L	M

The Situation analysis is conducted to decide the next route of the analysis technique process either Problem Analysis (PA), Decision Analysis (DA), or Potential Problem Analysis (PPA). Problem Analysis (PA) is focused on what is the faults in the past. Decision Analysis (DA) is focused on how to correct the present fault. Meanwhile, the Potential Problem Analysis (PPA) is focused on how to prevent future faults. By combining the Accident Historical Data, Pertamina DNV SCAT with KT Situation Analysis, the processing technique is served in Table V.

### C. Kepner Tregoe Decision Analysis (DA)

A decision statement is a process to concentrate on the objectives and limit the number of alternatives (Kepner & Tregoe, 1981). The objectives of Decision Analysis are generated by FGD with the HSSE Expert. The limitation to deciding between alternatives is dependent on the Must and Want Criteria. The limitations are mandatory consideration

(Must) and the desirable condition (Want) that is compared between decision alternatives. The root causes processed by DA technique are improper motivation, inadequate communication, and inadequate inspection. The process of DA technique for improper motivation is served in Table V while inadequate communication is served in Table VI and inadequate inspection is served in Table VII.

TABLE V: ACCIDENT ROOT CAUSE PROCESS TECHNIQUE

Root Cause	Type	Case in 2021	Technique
Lack of Knowledge	PF	Yes	PPA
Improper motivation	PF	Yes	DA
Goal conflicts	PF	No	PPA
Lack of Skill	PF	Yes	PA
Inadequate Communication	JF	Yes	PPA
Inadequate Supervision	JF	Yes	DA
Inadequate Inspection	JF	Yes	DA
Inadequate Work Standards	JF	No	PPA
Inadequate Equipment	JF	No	PPA
Inadequate Engineering	JF	No	PPA
Inadequate Changes	JF	Yes	PA
Unclear Command Structure	JF	No	PA
Excessive Wear	JF	No	PA

### D. Kepner Tregoe Problem Analysis (PA)

Definition of a problem or the deviation statement describes the name of the problem specifically and directly to the problem. Problem analysis will be directed and based on the name of the problem (Kepner Tregoe, 1981). The root causes processed by PA technique are lack of skill and inadequate changes. PA analysis for lack of skill is served in Table VIII and for inadequate changes is served in Table IX.

Based on Table VIII, the true cause of lack of skill is training or procedure to upgrade employee skills is not available. The proposed prevention program to solve this root cause is to create a work buddy system for the high and medium-risk job. Meanwhile, the true cause of inadequate changes are the conditions of new hazards in workplace that unknown by employees. The proposed prevention program to solve this root cause is Strengthen Job Safety Meeting before the work process which is an established prevention program. The root causes processed by PPA technique are lack of knowledge and inadequate supervision.

### E. Kepner Tregoe Potential Problem Analysis (PPA)

Potential problem analysis (PPA) is the technique to predict the future event and the consequences and also prepare mitigation to prevent the consequences. The PPA is the pattern to change and improve the future (Kepner Tregoe, 1981). Kepner Tregoe Potential Problem Analysis Consist of 4 activities: Identification of Vulnerable Areas, Identification of Specific Potential Problems, Identification of the Possible Causes and Preventive Actions, Identification of Contingent Actions (Kepner Tregoe, 2018). The PPA Process for this root cause is served in Table X.

### F. Survey Result

The surveys consist of 10 questions and were conducted in the period from 4<sup>th</sup> to 7<sup>th</sup> April 2020 and received a total of 186 respondents from Head Office Cirebon Area, Jatibarang Field Area, Subang Field Area, Tambun Field Area and Oil&Gas Transport Area. The respondent consists of top management, middle management, supervisors, office staff, and work executors from Pertamina, outsourcing and contractors.

TABLE V: IMPROPER MOTIVATION ROOT CAUSE PROCESS TECHNIQUE

Root Cause: Improper Motivation		Proposed Accident Prevention Program					
Must Criteria	Remind Work Procedure at Pre Job Safety Meeting	Personal Safety Motto for Everyone	Task Observation / Safety Awareness Supervision				
Influence and conducted by All employee structure (Organic and Contractors)	Go	Go	Go				
Implementation Duration and impact	Go	Go	Go				
Supporting infrastructure or equipment available in front liner	Go	Go	Go				
Easy to embedded in job sequence	Go	Go	Go				
Summary	Go	Go	Go				
Wants Criteria	Weight	Rating	Score	Rating	Score	Rating	Score
Low workload for employee	7	7	49	9	63	5	35
Low Cost	8	7	56	9	72	7	56
Easy to applied by all employee structure	5	8	40	9	45	8	40
Programs are easy to monitor	6	8	48	5	30	8	48
Sustainability effect	10	7	70	5	50	9	90
Total Score		263		260		269	
Conclusion		Not selected program		Not selected program		Selected program	

TABLE VI: INADEQUATE COMMUNICATION ROOT CAUSE PROCESS TECHNIQUE

Root Cause: Inadequate Communication		Proposed Accident Prevention Program					
Must Criteria	Work Handover and Job Review Checklist	Add Work Review in The Job Safety Meeting	Iman (Ingatkan Saya Jika Tidak Aman) Campaign				
Critical information reaches into frontline	Go	Go	Go				
Influence and conducted by All employee structures (Organic and Contractors)	Go	Go	Go				
Implementation Duration and impact	Go	Go	Go				
Supporting infrastructure or equipment available in the workplace	Go	Go	Go				
Easy to implement in job sequence	Go	Go	Go				
Summary	Go	Go	Go				
Wants Criteria	Weight	Rating	Score	Rating	Score	Rating	Score
Low workload for employee	7	7	49	7	49	9	63
Low Cost	8	7	56	7	56	9	72
Easy to apply by all employee structure	5	7	35	8	40	9	45
Programs are easy to monitor	6	7	42	7	42	9	54
Sustainability effect	10	9	90	9	90	7	70
Total Score		272		277		304	
Conclusion		Not selected program		Not selected program		Selected program	

TABLE VII: INADEQUATE INSPECTION ROOT CAUSE PROCESS TECHNIQUE

Root Cause: Inadequate Inspection		Proposed Accident Prevention Program				
Must Criteria	Work Handover and Job Review Checklist	Add Work Review in The Job Safety Meeting				
Covers equipment in the high and medium-risk job	Go	Go				
Covers Pertamina and contractors' equipment	Go	Go				
Frontline able to conduct the inspection	Go	Go				
Implementation duration and impact	Go	Go				
Summary	Go	Go				
Wants Criteria	Weight	Rating	Score	Rating	Score	
Low workload for employee	7	7	49	6	42	
Low Cost	8	9	72	9	72	
Easy to apply by all employee structure	5	7	35	9	45	
Programs are easy to monitor	6	9	54	7	42	
Sustainability effect	10	9	90	7	70	
Total Score			300		271	
Conclusion			Selected program		Not selected program	

TABLE VIII: PA ANALYSIS FOR LACK OF SKILL

Problem Statement		Lack of skill		
Problem Specification	Is	Is Not	Distinction / Key Information	Possible Cause
What	Skills to conduct the job	Knowledge to conduct the job	"Knowledge is information or awareness gained through education or experience, meanwhile Skill is the ability possessed to do something well Specific hazard	Skills are acquired through practice. Knowledge has been given at the Basic HSSE Learning Training, but training procedures/methods to upgrade employee skills are unavailable Specific hazards in the operation area
Where	Travelling Block Rig PDSI, Control Pond SPUA, XAP Xray	Oil Well Area, Power Plant, Office, Construction Site		
When	During Work Process	During Preparation Process	Work process involves skills and knowledge, job preparation requires knowledge	low skill employees tend to raise the chance of accident case
Extent	Contractors	Pertamina Employee	Risk in the work process	Differences in duties and Responsibilities

TABLE IX: PA ANALYSIS FOR INADEQUATE CHANGES

Problem Statement		Inadequate Changes		
Problem Specification	Is	Is Not	Distinction / Key Information	Possible Cause
What	Changes in Workplace Condition	Changes in Work Procedure	changes in the workplace condition create a new hazard for an employee	changes that cause new hazards are unknown to the employee
Where	Travelling Block Rig, Rigsite, Boiler	Workshop, WareHouse	"The work process changes according to job orders	The Hazard changes depend on the job order
When	Engine/Equipment Operation Time	Engine/Equipment Maintenance Time	Wokk process in workshops and warehouses tends to be routine"	Unknown Hazard during the operation time
Extent	Complex Equipment	Simple Equipment	Specific hazards for each operation time, and similar hazards due to maintenance time	Complex Equipment brings more hazard

TABLE X: ACCIDENT ROOT CAUSE PPA TECHNIQUE

Potential Problem	Possible Cause	Preventive Action	Contingent Action
Lack of Knowledge	1. Employee able to pass Basic HSSE Exam, but fails to implement in the workplace 2. Employees cannot remember all Basic HSSE Learning in the workplace	1. Periodically Conducts random tests in employee workplace. 2. Conduct BHL Training refreshment (established program)	1. Create a Question Bank for Basic HSSE Learning Training 2. Training Refresh for the employee with a high-risk and medium-risk job
Inadequate Supervision	1. The supervisor fails to check or visit the workplace 2. Employees work carelessly if not supervised	1. Provide Mandatory Checklist Form for Supervisor, especially for High and Medium Risk. 2. Recruit more supervisors for hazard surveillance	1. Add Supervisor Work Checklist Route Form 2. Provide Special Contract as Hazard Control

The majority of Respondents, 112 persons (60%) agree that the accident is caused by a lack of HSSE Implementation. In the other question, 119 persons (64%) agree that the established accident prevention program is already effective meanwhile 151 persons (81%) agree that the Company needs more accident prevention programs. These two questions indicate that the respondent thinks that despite the effective established program, more programs should be launched to prevent accident.

Related to the condition above with the next question, the respondent wants the prevention program to be socialized and supported by more resources.

The majority of respondents, 134 persons (72%) agree that the employees' commitment is the key to the success of the accident prevention program. Of the respondents, 98 persons (58%) agree the accident is threatening the business continuity.

G. Focus Group Discussion Result

Brainstorming Method by Focus Group Discussion (FGD) is conducted on March, 23<sup>rd</sup> 2022, with a meeting duration of about 180 minutes. FGD is attended by HSSE Manager, Safety Assistant Manager and the HSSE Superintendent from 4 oilfield Operation Area (Tambun, Subang, Jatibarang & OGT). FGD is conducted to design the prevention program based on the historical data, must and want categories, the weight of want criteria, evaluate the problem analysis, evaluate the potential problem and finally determine the priority or rank of an accident prevention program. The result of FGD is the proposed and evaluation of an accident prevention program by a method of Pertamina DNV SCAT and Kepner Tregoe.

## V. CONCLUSION

The number of accident cases requires the number of accident prevention programs and recommendations for follow-up. This condition caused the program to be out of focus, and waste company resources and each case will be handled equally despite the frequent accident. The Priority of the prevention program aimed as the solution to this problem, ensure the business sustainability and achievement of the company target. The priority of the accident prevention program is determined by the relative percentage of root causes and the KT Situation Analysis. Root Causes processed by Decision Analysis (DA) technique will be the priority followed by Potential Problem Analysis (PA) and Problem Analysis (PA).

### A. Personal Factor Root Cause

Four dominant personal factors are Lack of Knowledge (38.10%), improper motivation (26.19%), goal conflicts/job shortcuts (19.05%), and lack of skills (14.29%).

### B. Job Factor Root Cause

Five dominant personal factors are inadequate supervision (15.79%) dan inadequate communication (15.79%), inadequate inspection (14.47%), inadequate work standards (14.47%), and inadequate tools and equipment (11.84%).

### C. Decision Analysis (DA) Prevention Program

Considering the Must and Want objectives, Decision Analysis (DA) designed and select an accident prevention program. The first recommendation, Task Observation / Safety Awareness Supervision is the solution for the improper motivation root cause. Pertamina DNV Relative Percentage for this root cause is 26.19% in the Personal factors category. Second. The established program, Iman (Ingatkan Saya jika Tidak Aman) Campaign is the solution to the inadequate communication root cause. Pertamina DNV Relative Percentage for this root cause is 15.79% in the Job factors category. Third, Another Established Program, Strengthen Work in Progress (WIP) Assessment in CSMS (Contractor Safety Management System) is the solution to Inadequate Inspection and Maintenance root cause. Pertamina DNV Relative Percentage for this root cause is 14.47% in the Job factors category.

### D. Potential Problem Analysis (PPA) Prevention Program

Potential Problem Analysis (PPA) considers vulnerable areas, possible causes, preventive actions, and contingent actions, to select Accident prevention program. The first recommendation, Periodically BHL (Basic HSSE Learning) test to employee workplace and Conduct BHL Training refreshment (established program) as the solution for lack of knowledge of accident root cause. Pertamina DNV Relative Percentage for this root cause is 38.10% in the Personal factors category. The second recommendation is to Provide a Mandatory Checklist Form for Supervisor, especially for High or Medium Risk, and Recruit more supervisors for hazard surveillance as the solution for the inadequate supervision accidents' root cause. Pertamina DNV Relative Percentage for this root cause is 15.79% in the job factors category.

### E. Problem Analysis (PPA) Prevention Program

Problem Analysis (PA) process considers "Is" and "Is Not" categories, key information extraction, testing the most probable causes, and the verification of the true cause, to select an accident prevention program. The first recommendation, Buddy System for high-risk jobs as the solution for Employee Lack Of Skills accident root cause. Pertamina DNV Relative Percentage for this root cause is 14.29% in the Personal Factors category. Second, Strengthen Job Safety Meeting before working (established program) as the solution for Inadequate Changes in Workplace. Pertamina DNV Relative Percentage for this root cause is 5.26% in the job factors category.

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## CONFLICT OF INTEREST

Authors declare that there is no conflict of interest.

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