Proceeding of Ocean, Mechanical and Aerospace
-Science and Engineering-, Vol.2

October 21, 2015

Qualitative Risk Analysis of Safety and Health in the Construction Project of Toll Roads Over The Sea (Nusa Dua-Ngurah Rai-Benoa)

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Paper History

Received: 12-October-2015
Received in revised form: 16-October-2015
Accepted: 20-October-2015

ABSTRACT

Toll Road Development Project Nusa Dua - NgurahRai - Benoa, Bali is a big project that does not escape from the various safety and health risks due to the work done fixing some point in the middle of the sea that is a big risk. Poor risk management on the project will cause the loss is not small. Late work is also one that allows the risk to occur. The purpose of this study is to identify risks to safety and health on highway construction projects over the ocean (Nusa Dua – Ngurah Rai - Benoa) through brainstorming and interviews using questionnaires to the parties involved in handling-highway construction, and assess the risks identified so getting risks dominant (major risk), the risk categories are not acceptable (unacceptable) and the risk is not expected (undesirable), which is then performed mitigation measures to reduce the risk. In this study, the risks identified are as many as 43 (forty three) and is divided into 3 activity is a routine activity in the project area, offices, warehouses, workshops, public activity of which is the mobilization and demobilization in the field and the main activities include piling work, bar cutter/bender, formwork, casting concrete, paving and electrical installations. Risks that are obtained from natural sources of risk, project risk, technical risk and human risk. After the assessment, there are 6 categories of risk is not acceptable (unacceptable) and 14, the risk included in the category not expected (undesirable).

KEY WORDS: *Qualitative, risk risk analysis, identification, toll roads over the sea, assessment, mitigation.*

1.0 INTRODUCTION

Health and work safety issues in Indonesia isgenerally often overlooked. This is indicated by the high number of work accidents. Chairman of the IndonesianAssociation of Work Safety and Health Construction (A2K4) Iksan Z ZainiAnas said, "every year there are 96,000 cases of occupational accidents". Of these, the majority of work accidents occur in construction projects and the rest happens in the manufacturing industry sector.

The obligation to run the management system of health and safety at the company's large enterprise through labor law has resulted in 2.1% of the more than 15,000 large-scale enterprises in Indonesia are already implementing management system of health and safety. The lack of quantity was largely due to the persistence of the notion that the health and safety program will only be an additional expense of the company.

Toll Road Development Project Nusa Dua - NgurahRai - Benoa, Bali is a big project that does not escape from the various safety and health risks due to the work done fixing some point in

the middle of the sea that is a big risk. Poor risk management on the project will cause the loss is not small. Late work is also one that allows the risk to occur.

Road construction projects Toll Nusa Dua - NgurahRai - Benoa, Bali is done jointly by PT JasaMarga Bali Toll which is a consortium of state-owned enterprises (JasaMarga, AngkasaPura I, Pelindo III, AdhiKarya, Waskita, WijayaKarya and WijayaKarya), As for the details of share ownership is: PT JasaMarga 60%, PT Pelindo III 20%, PT AngkasaPura I 10%, PT WijayaKarya 5%, PT Hutama 2%, PT AdhiKarya 2% and the Bali Tourism Development 1%. The toll road was built 11 km with a total investment reached 2.3 trillion. Operation of toll road concession period is for 45 years since the work order by the Toll Road Regulatory Agency.

The project was undertaken in four packages and implemented by several contractors, and based on interviews with those who deal with safety and health project there were a few issues relating to occupational health and safety in highway construction projects above the sea. Based on this background, this study was conducted to identify, assess and risk management of the risk occurring.

2.0 LITERATURE REVIEW

2.1 Definition of Risk

Do things according to plans made is expected by everyone, but on the other hand often occur rarely matters in accordance with the plan that pose a risk. Each activity in daily life is always going to pose a risk because there is no activity that is free from risk, so the mindset that everything happens according to plan (AGAP or All Goes According to Plan) should be amended with the approach pattern Whif Analysis (What Happens If) is the approach pattern to the question of what happens when something is not in accordance with the plan [1]. Risk is a measure of the opportunities and consequences of not achieving the project objectives have been set [2]. There are several definitions of the risks as follows [3]:

a. Risk is the chance of loss (the risk is the possibility of loss).
Risks to the above understanding, usually used to indicate a situation where there is a loss or a chance against possible losses.
b. Risk is the possibility of loss (the risk is the possibility of losses).
c. Risk is uncertainty (risk is the uncertainty).
That it is very important to put the uncertainty (uncertainty) as a starting point in risk management [4]. Risk and uncertainty are two key characteristics in the business and government problems that must be understood in order to make decisions rationally [5].

According to the Construction Research Industry and Information Association (CIRIA) the risk can be sourced from various activities, among others, politics, environment, planning, market, economics, finance, natural (natural), project , engineering (technical), human, crime, and safety [6]. Source of risk is the main categories (major), among other sources of client / government such as changes in local regulations and bureaucracy, financial risks such as changes in the financial policy of the government, project risks such as changes in part (scope) of projects, the organization's risk project example authorized project managers involved in the organization, risk planning (design), the risk of local conditions (weather), the risk of contracting as implementers such as experience and financial situation of the contractor, the risk of material for construction, the risk of labor, the risk of logistics (access to the site) , inflation risk, the risk of price changes and the risk of force majeure [7].

Types of risk are also divided into pure risk and the risk of speculation [8]. Pure risk means it will have the chance of a loss / loss, which includes physical damage to the company is the result of fraud or criminal acts. Speculation implies risk is likely to profit or loss in a company, including the risks of marketing, production, finance caused due to the market environment, politics, technology and economics.

In a project management, as a result of the risk of the most common are as follows [9] :

a. Failure to maintain the estimated costs.
b. Failure to achieve complete data are required.
c. Failure to achieve quality and operational needs.
The risk analysis is qualitatively has two objectives, namely risk identification and assessment of risk, where the goal was to develop a source of major risk and describe the extent of the consequences is often the case, including estimates on the effect of potential on the estimated cost and time, whereas quantitative analysis focused on risk evaluation [9]. Three techniques are typically done on a qualitative risk analysis:

a. Compile a list (check lists) risk based on previous experience.
b. Conducting interviews with key personnel on the project (people who are experienced in the field).
c. Do brainstorming (idea) by the project team.
Qualitative risk analysis is the process of assessing the effect of the strong and the possibility that occur in identifying the risks, this process of prioritizing risks according to the potential consequences inflicted on the project objectives to be achieved [10]. Things that become inputs (input) in conducting qualitative risk analysis, namely risk management plan, identify risks, project status, project type, data is meticulous, scale on the probability and impact, and make assumptions.

2.2 Definition of Health and Safety

Risk management health and safety is an attempt to manage risk to prevent unwanted accidents in a comprehensive, well-planned and structured in a good system. Risk management health and safety with regard to the hazards and risks that exist in the workplace that can cause harm to the vendor [11].

Work accident is an event that is clearly undesirable and often unpredictable originally that can cause harm either time, property or property and even loss of life that occurred in a work process [12]. From that sense it implies work accidents caused by unexpected because accidental and undesirable because it always causes material and moral losses.

The main causes of construction accidents are generally grouped into three as follows [13]:

1. The construction of a dangerous condition, for example, the collapse of the construction less stable at the time of implementation.
2. An environmental hazardous conditions such as heat stress, noise, dust, radiation, vibration, and the like.
3. The human factor Yag often referred to as unsafe acts (unsafe

action), the behavior of workers who endanger themselves and work environment. In general, this occurs because of lack of knowledge or understanding of the workers against the rules of safety.
4. Unavailability of safety standards, for example, there is no provision of workspace and standards for the handling of hazardous materials.
5. Failure of communication.

3.0 RESEARCH METHODS

The study was conducted on toll roads NgurahRai- Nusa Dua-Benoa with descriptive qualitative research methods. Qualitative descriptive method aims to create a description, picture or painting in a systematic, factual and accurate information regarding the relationship between the phenomenon will be investigated. Qualitative descriptive method used is a survey method that aims to get the opinion of respondents on the risks of occupational safety and health on highway construction projects over the ocean (Nusa Dua - NgurahRai - Benoa), thus the descriptive method that is produced in the form respondents' opinions to be proved again in fact. The data collection in this study are as follows:
1. Secondary Data Collection
Secondary data were obtained from the data taken from the journals, and literature study to obtain early risk identification.
2. Primary Data Collection
Primary data in this study is data respondents' opinion. Identify the risks resulting from the assessment of secondary data (previous studies, journals, literature) and then developed with observation / field investigations and interviews and brainstorming with related parties. If the identification of risk it is no longer possible to be developed, followed by an interview with the help of a questionnaire regarding various possible occurrence (likelihood to occurrence) and influence (potential consequences) and risk of loss. Respondents in this study are those who have been involved in highway construction projects Nusa Dua - NgurahRai - Benoa in parts of occupational safety and health as coordinator field of work package 1 to package 4, including third-party contractors involved in Package 1 up Package 4, and Jasa Marga Bali Toll as the owner. After the brainstorming and respondents could give their opinions openly regarding mitigation measures (mitigation action) that needs to be done to address and mitigate the risks that occur.

Questionnaireform is semi-closed are mostly in the form of closed questions to answer based on the options available regarding the scale of likelihood / probability (chance) and consequences (result / impact) risks of the risks identified and partly in the form of open-ended questions provide an opportunity for respondents to add identification the risk that the respondents consider there is a risk that has not been identified. Risk assessment at this stage will ultimately result in risk acceptability. Of the value given by the respondents in each risk identification can be determined that the data mode as a representation of respondents to the opinion of the risks identified. In providing for the possibility of assessment (possibility) using the scale of each category, which is defined as follows [6] :

Table 1: Frequency Scale (Likelihood)

Frequency Level	Chance	Scale
Very High	≥ 80%	5
Often	60 ≤ – < 80%	4
Sometimes	40 ≤ – < 60%	3
Rarely	20 ≤ – < 40%	2
Very Rarely	< 20%	1

The value of risk possibility is a big value which states the possibility of such events asrisk. As for the reviews to measure the level of influence of the project against risk variables, use the following as scale [6] :

Table 2: Consequence Scale

Consequence Level	Chance	Scale
Very Big	≥ 80%	5
Big	45 ≤ – < 80%	4
Average	15 ≤ – < 45%	3
Small	5 ≤ – < 15%	2
Very Small	< 5%	1

Then analyzed the level of risk acceptability that depends on the value of risk that the multiplication of inclination (likelihood) and consequence of risk. With the level of risk acceptance and taking into account the risk that the value obtained from the scale of consequences and likelihood scale, it can be arranged scale acceptance of risk (risk acceptability) as follows:

Table 3: Risk Acceptance Scale

Acceptance Risk	Acceptance Scale
Unacceptable	> 12
Undesirable	6 < - ≤ 12
Acceptable	2 < - ≤ 6
Negligible	≤ 2

Based on the risk acceptability is then conducted an evaluation of the risks identified in a questionnaire that requires mitigation measures. The criteria for the risks that require mitigation actions are all risks are unacceptable and undesirable.

The allocation of risk ownership is also very important, especially for the category of unacceptable risks and undesirable, because it requires the best control of each of the parties responsible for the risk.

4.0 RESULTS AND DISCUSSION

Identification of health and work safety risks on highway construction projects over the ocean Nusa Dua-Benoa-NgurahRai is as follows:
I. Regular activity
A. Project Area
1. Workers injured due to a collision with another vehicle in the project area
2. Workers minor injuries due to slippage due to slippery roads and vehicle tires that have been unsuitable
B. Project Office
3. Workers electric shock because the cord is exposed / work are

not careful in the project office
C. Warehouse materials / tools
4. Workers crushed injury in time to save a pile of goods / material in warehouses of materials / tools
D. Workshop iron
5. Workers injured because of leg stump when transporting iron scrap iron in iron workshop
E. Wood Workshop
6. A worker injured by sawing wood / wood plank in workshop
II. General activity
Mobilization and demobilization
7. Workers injured by heavy equipment slipped from top of the trailer due to a lack of supervision of the implementing current lower/raise the machine at the time of mobilization and demobilization of heavy equipment on the ground
8. Worker injured by heavy equipment slipped from the top of the pontoon due to a lack of supervision of the implementing current lower / raise the machine at the time of mobilization and demobilization of heavy equipment in the water / sea
9. Workers sink with pontoons and luggage that exceeds the capacity of the pontoon
10. Workers injured due to the exposure equipment, which projects are scattered on the road due to the slip vehicle and road conditions are not good at the time of mobilization and demobilization work in the project area land
11. Workers injured by maneuvering the tool at the time of mobilization
III. Main activity
A. Work piles
12. Workers injured by piling slipped from the top of the trailer due to bond the pile above the trailer loose / off, at the time of the transport work piling
13. Workers injured due to hit the pile fell because trucks carrying piles upside down due to overcapacity and the road collapsed
14. Workers were seriously injured due to collapse of the crane arm crane broken due to overweight at the time of lifting the pile from above trailer
15. Workers had seriously injured by falling poles that fell as a result of a sling / strap lifter crane dropped out due to adverse weather conditions and high winds
16. Workers were seriously injured by falling piles of piles, which rolled in the project area
17. Workers suffered serious injuries because of a pontoon tilt / reverse charge as a result of overcapacity piling pontoon
18. Workers were seriously injured hit by piles of broken as a result of colliding with a pontoon that does not pay attention to pontoon moorings and current waves
19. Workers were seriously injured as a result of hits pile of bat stake tool does not work properly
20. Workers with hearing loss due to noise at the time of erection work
21. The injured worker crushed by the weight of piles of broken when lining
22. Workers were seriously injured due to hit swing tool stake due to lack of caution when the stakes were swing tool
23. Eyes splash workers when cutting concrete piles
24. There was an explosion / fire / short-circuit that endanger workers during splicing piles
25. Accidents workers on pontoon drift due to currents and high seas are unpredictable
26. Accidents due to workers falling from height porous scaffold conditions that influenced the tide
27. Workers fell into the water when the work PDA Test
B. Work in ironing
28. Workers had an accident because of the absence of lightning rod installation
29. Fingers worker injury / disability due to a finger cut off tool at the time of job cuts of ironing
30. Workers experiencing eye irritation due to splash the powder at the time of job cuts of ironing
31. Workers injured / cracking in the affected body part iron that bounced on the job when bending the iron
C. Installation of formwork for pile cap pile
32. Workers injury waist / shoulder / arm due to awkward postures when lifting and installing formwork down when the result of a lack of direction and an explanation of ergonomic working position to workers
33. Workers injured on the foot / hand scraped / punctured metal tip or a nail or other sharp object as a result of the placement and the dismantling of the iron beams scattered former formwork installation
D. Casting concrete.
34. Accidents due to batching plant workers pontoon jog or hit by another boat due to a lack of control when the batching plant is operating pontoon
35. Workers injured by nails and other sharp objects because of the lack of lighting at night in foundry work
36. Workers falling from a height at the time of casting due to the absence of safety stairs wearing railing
37. Workers experiencing skin irritation due to exposure to liquid concrete during concrete placement
38. Workers were seriously injured as a result exposed precast concrete crane arm broken because of high wind speeds that comes on suddenly
39. Workers fall into the water at the time of installation of precast slab
E. Work asphalting
40. Workers had an accident because of explosion when working with high temperatures in the paving work
41. Workers suffered burns due to splash asphalt
F. Electrical installations
42. Worker falls from height in the installation of lampposts and electricity networks
43. Workers electric shock during the installation of cables for electricity.

There are 43 (forty-three) risks have been identified, the amount of risk most at risk projects sourced by 51.16%, after it comes to the technical risk at 25.58%, 16.28% risk of human and natural risks amounted to 6.98%.

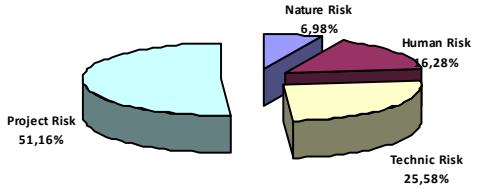

Figure 1: Percentage of Total Risk Based Sources of Risk

The mode is selected scale as the representation of the largest of the frequency and consequences of events by 14 (fourteen) of respondents in each risk occurring, the risk value is the result of multiplying the likelihood and consequences risk, based on the value of risk is then determined the level of risk acceptability on each of the risk that the result is six risk categories are unacceptable, 14 risk categories are undesirable, 15 risk categories is acceptable, and only 8 risks included in the category negligible.

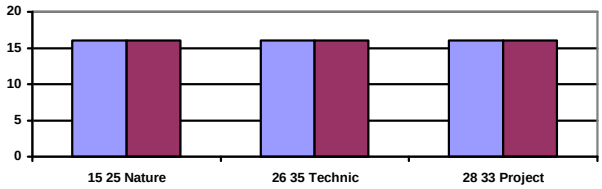

Figure 2: Unacceptable Risks,
Risks Value and Sources

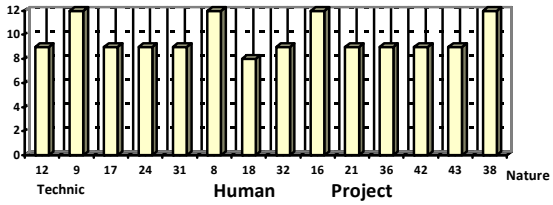

Figure 3: Undesirable Risks, Risks Value and Source

5.0 CONCLUSION

From the research conducted, it can be summed up as follows:
1. Identification of occupational health and safety risks in the construction of toll roads over the sea Nusa Dua-Benoa-NgurahRai based on secondary data and primary data obtained by 43 (forty three) and is divided into 3-risk activity. Risks that are obtained from natural sources of risk, project risk, technical risk and human risk.
2. Major risk obtained were categorized as unacceptable and undesirable. There are six risk categories of unacceptable is the worker had seriously injured by falling poles that fell as a result of a sling / strap lifter crane dropped out due to adverse weather conditions and strong winds, an accident of workers on the pontoon drift due to currents and high seas are unpredictable, accident workers falling from heights due to the condition of the scaffold is porous which influenced the tide, workers injured by nails and other sharp objects because of the lack of lighting at night in foundry work, the worker had an accident because of the absence of the installation of a lightning rod, workers injured on the feet / hands scratched / punctured metal tip or a nail or other sharp object as a result of the placement and the dismantling of the iron beams scattered former formwork installation. The risks included in unacceptable risk and undesirable risk mitigation risk to minimize the negative impacts that may occur and do the allocation of ownership risk to those involved in this project which aims to make all such risks completely under control one of the parties and can be handled properly.
3. The risks included in unacceptable risk and need to be undesirable risk management (risk mitigation) to minimize the negative impacts that may occur and do the allocation of ownership risk to those involved in this project which aims to make all the risks really are under the control of either party and can be handled well. Risk mitigation measures against workers seriously injured by falling poles that fell as a result of a sling / strap lifter crane dropped out due to adverse weather conditions and high winds are provide induction on health and safety to the operator and executor and always reminded to keep safety, make sure and check the bonding pile is good and true, lifting the stake does not exceed the lifting capacity of crane, ensuring sling material (rope) is a material that is strong crane to lift the stake, crane has operational license, crane operator has the operating license, put up signs that there is activity appointment, wear Personal Protective Equipment :
a. Safety Helmet
b. Safety Shoes / Safety Boots
c. Safety gloves
And in cooperation with the meteorological agency to obtain data on wind speed, mitigation actions at risk of workplace accidents on the pontoon drift due to currents and high seas unexpected is the same as the previous action above and added by installing signs to always remember be careful in work and check the pontoon before operation, mitigation actions at risk of occupational accidents fell from a height because of the condition of the porous scaffold that influenced the tide is always perform the control of the scaffolding used in the field for endangering workers and passersby, attach a safety rope (life line) to associate a safety harness, and wear personal protective equipment, mitigation actions at the risk of workers injured by nails and other sharp objects because of the lack of lighting at night in foundry work is cleaning immediate work area was not clean and cluttered by the workers concerned as well as housekeeper field, all the nails or sharp objects contained in blocks ex dibengkokan or revoked, made a special way for workers and pedestrians passing in the project area, morning safety briefing to workers, giving a description of the technical work that is safe formwork and possible dangers that arise, 200-300 lux illumination lights project, housekeeping implemented by all workers without exception, the application of the principle of 5R entire work area without exception, sanctions for workers who are not wearing personal protective equipment, the minimum standards that are

required when entering the work area, wear personal protective equipment, risk mitigation measures at worker had an accident because of the absence of lightning rod installation is to install lightning rods on the job open areas and in sea, Mitigation actions at the risk of workers injured on the foot / hand scraped / punctured metal tip or a nail or other sharp object as a result of the placement of dismantling the iron and blocks of the former installation of formwork scattered is cleansing immediate work area was not clean and cluttered by the workers concerned as well as housekeeper field, all the nails or sharp objects contained in the beams the former bent or revoked, made a special way for workers and pedestrians passing in the project area, safety morning briefing to workers, giving a description of the technical work of formwork safe and possibilities danger arises, morning safety briefing to provide an explanation of the technical workers jobs safe formwork and possible dangers that arise,
provision of inorganic solid waste disposal sites while for pieces of metal formwork jobs are limited by safety line, sanctions for workers who do not wear personal protective equipment such minimum standards required when entering the work area.

ACKNOWLEDGEMENTS

We would like to convey a great appreciation to Ocean and Aerospace Engineering Research Institute, Japan for supporting this research and we hope this research is useful and can be followed by subsequent research and collaborate with other disciplines.

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