

Analysis of Safety Cost Structure in Infrastructure Project of Main Dam Based on Work Breakdown Structure (WBS)

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Abstract:

Work activities on construction projects can have problems caused by various things, one of them is workplace accidents. Early identification and analysis of potential hazards in each work package, implementation method, work activities, resources and the existing environment can prevent work accidents from occurring. But the application of an occupational health and safety management system is still not optimal, this is due to the absence of a separate budget in this sector. Thus, financing in this management system is taken from the project budget, which causes a reduction in the profits of the construction company. This study aims to develop the safety cost based on Work Breakdown Structure (WBS). The research methods are survey research and descriptive analysis. The study results are the dam standardized WBS, potential hazard sources, the preventive action to each potential hazards in each activity, finding the safety cost components based on WBS and the calculation of safety cost percentage in order to improve the OHSMS quality and reducing work accidents in the dam projects.

Keywords: Work Breakdown Structure, Dam Project, Safety Plan, Cost of Safety

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I. INTRODUCTION

Infrastructure can influence construction industry. Because infrastructure is the most important element in developing a country. The construction industry has an important role in developing economy in a country (Yilmaz Kanit 2018)[1]. The one of important infrastructure is dam construction. Dam construction is a complex construction because the scopes and limited by time, resources and method (Hidayah, Latief, Sagita 2018)[2]. This condition will influence safety requirements.

In Indonesia, safety is not the main priority. There were 110,285 occupational accidents where there was a decrease in 2016 to 101,367 cases or 8% with 2,375 fatalities with claims 792 billion rupiahs (Deny, 2017)[3]. Negative impacts will happen caused by the high number of work accident and also casualties (Lingard & Rowlinson 2005)[4].

Hazard identification and determining risk control is very important to do to prevent construction accidents. In construction, activities or conditions that have a potential to produce injury or death is the

definition of hazard. Work Breakdown Structure (WBS) is the basis to identify potential hazard. Hazard identification and determining risk control is the first step to make a safety plan which regulated in Ministerial Regulation 05 / PRT / M / 2014 which explain the occupational health and safety system in public work.

A good safety management systems have an important role in construction project and will influence a project performance (Cheng et al 2012)[5]. A good safety management can be applied with a good commitment and also cost. Preparing a budget for safety is very important to support construction project. In many projects, the safety budget is not determined separately, and the associated costs are paid from the project budget, causing the implementation of a safety management system to experience problems (Toutounchian et al., 2018)[6].

In Indonesia, We have a regulation which to arrange the provision of safety budget. Base on Regulation of the Minister of Public Works Number

28/PRT/M/2016, safety cost divided by 3, i.e. general cost, specific cost and security cost. But Letter of the Minister of Public Works Number 11/SE/M/2019 shows that safety cost consist of Personal Protective Equipment, Safety Plan, Socialization, Promotion and Training, Working Protective Equipment, Insurance and Licensing, Safety Personnel, Medical Facilities, Infrastructure and Devices, Safety Sign, Consultation with Experts Related to Construction Safety, Others[7]. But the fact, many construction company don't apply safety cost because it is not clearly identified. From the description, research in developing a safety plan base on WBS to determine safety cost become important to increase the safety performance

II. LITERATURE REVIEW

A. Work Breakdown Structure (WBS)

Work Breakdown Structure is a project breakdown into smaller parts in order to manage easily (Pratita & Latief, 2018)[8].

B. Final Stage

The danger of the activity or condition has a measure of possibility and impact, this is called risk (Baradan & Usmen, 2006)[9]. Project risk is an uncertain event which has a positive or negative impact towards project objectives. If the event occurs it can affect project scope, schedule, cost, or quality (Rianti et al., 2018)[10].

C. Safety Plan

In Indonesia, safety planning document in the regulation is known as the Work Occupational Safety and Health Plan (RK3K) (Elsye et al., 2018)[11]. Preparation of Safety Plan using WBS standard based on safety planning in attachment of Ministerial Regulation 05 / PRT / M / 2014, and has been added with WBS level taken sample at some risk with high potential value (Elsye et al., 2018)[11].

D. Safety Cost Components

Base on Regulation of the Minister of Public Works Number 28/PRT/M/2016, safety cost divided by 3, i.e. general cost, specific cost and security cost[12]. But Letter of the Minister of Public Works Number 11/SE/M/2019 shows that safety cost

consist of Personal Protective Equipment, Safety Plan, Socialization, Promotion and Training, Working Protective Equipment, Insurance and Licensing, Safety Personnel, Medical Facilities, Infrastructure and Devices, Safety Sign, Consultation with Experts Related to Construction Safety, Others[7].

1) General Cost

Based on the Regulation of the Minister of Public Works and Public Housing Number: 28 / PRT / M / 2016 concerning Guidelines for the Analysis of Unit Prices for Public Works, there are a number of provisions regarding general OHS costs as follows: Occupational Safety and Health Costs Construction of a general nature in accordance with the Minister of Public Works Regulation No. 5 of 2014 concerning Guidelines for the Management of Occupational Safety and Health (SMK3) Systems in the Field of Public Work is included in the general cost, Calculation of costs for general OHS requirements such as Personal Protective Equipment (PPE): helmets, vests, shoes, masks, raincoats, hats, gloves, protective goggles and others have been calculated in general overhead costs.

2) Specific Cost

Based on the Regulation of the Minister of Public Works and Public Housing Number: 28 / PRT / M / 2016 concerning Guidelines for the Analysis of Unit Prices for Public Works, there are several provisions regarding specific costs as follows: For special OHS requirements, for example: diving equipment, acidic or other equipment must be accommodated in the mobilization of equipment (preparatory work), Special OHS items in the Cipta Karya sector include: Mobilization: K3 personnel, Work Protective Equipment (APK), signs, Health facility facilities and Labor and licensing insurance.

3) Security Cost

Based on the Regulation of the Minister of Public Works and Public Housing Number: 28 / PRT / M / 2016 concerning Guidelines for the Analysis of Work Unit Price for Public Works, there are several provisions regarding K3 AHSP as follows: Specifically for specific protection, it must be accommodated in special K3 AHSP marked (K3) such as to protect the workforce at the time of excavation required reinforcement wall of earth excavation such as AHSP T.12

(K3), Provisions of safety AHSP items in the Cipta Karya sector include the work of safety nets.

III. METHODOLOGY

This research is a qualitative approach. Research survey is used to collect data from experts. Data will be analyzed using descriptive analysis. Fig. 1 shows the process of the research.

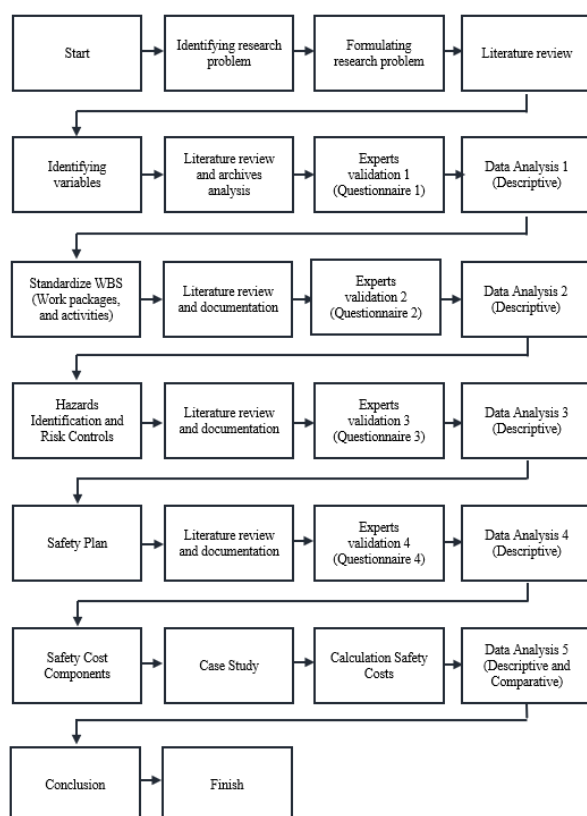


Fig. 1 Research Process

A. Research Variable

There are 6 variables X and 1 variables Y which are grouped in 5 stages of research as shown in Table 1. There are 3 sub variables and 11 indicators to obtain variable Y.

X1 = Work Package
X2 = Activities
X3 = Potensial Hazards
X4 = Safety Risk Control
X5 = Safety Specific Target
X6 = Safety Program
Y = Safety Cost

Y.1 = General Cost

Y.2 = Specific Cost

Y.3 = Security Cost

B. Research Instrument

In collecting data of the research, questionnaire is used in survey. There are 4 kinds of questionnaire base on the research objectives. And questionnaire is used to collect the safety component. Guttman scale is applied in each questionnaire to get the the firm answer “yes” or “no” (Sugiyono, 2018)[13]. Guttman scale is used in these instruments.

C. Sampling Technique

Respondents in this research are selected by non probability sampling technique (Sugiyono, 2018)[13] and expert judgement (PMI, 2017)[14]. The requirements to become a sample are consist of 3 to 5 experts who has 10 years professional experience in bridge project and construction safety, minimum bachelor degree. Respondent can be academics, professional associations and practitioners who have minim qualify as project manager, site engineering manager, site manager and safety manager.

IV. RESULT AND DISCUSSION

The result of the research are as follows:

A. Developing a Standardized WBS

In order to achieve the research objective no. 1, identify previous standardized WBS for main dam construction from Hidayah, Latief, and Riantini (2018)[2] and Mustain, Latief and Riantini (2019)[15]. Ask for the expert to validate the WBS. The expert will identify the level of WBS, Level 1: Project Name, Level 2: Work Section, Level 3: Sub – Work Section, Level 4: Work Package, (Alternative Methods / Design), Level 5: Activities, and Level 6: Resources.

B. Hazard Identification and Determining Risk Control

Inorder to achieve the research objective no. 2, from the literature review which are confirmed, potential hazards and risk controls which have influence to safety performance are clarified and validated by experts. The experts will give their

opinions whether the potential hazards and risk controls are suitable or not. The format table for hazard identification, risk assessment and determining control is shown in Table 1.

C. Developing A Safety Plan

In order to achieve the research objective no. 3, the next step after identifying potential risks and risk controls is developing a safety plan following the Regulation of the Minister of Public Works Number 05 / PRT / M / 2014 which consist of safety specific target and program. The safety plan are clarified and validated by the safety experts. Their opinions and comment is used to improve the safety plan. The format table for safety plan which consist of target or objective and program is shown in Table 2.

D. Determining Safety Cost Component

In order to achieve the research objective no. 4, the next step is determining safety cost component. Safety plan is a basis for determining safety cost components base on Regulation of the Minister of Public Works Number 28/PRT/M/2016, where b safety cost divided by 3, i.e. general cost, specific cost and security cost also the Letter of the Minister of Public Works Number 11/SE/M/2019 shows that safety cost consist of Personal Protective Equipment, Safety Plan, Socialization, Promotion and Training, Working Protective Equipment, Insurance and Licensing, Safety Personnel, Medical Facilities, Infrastructure and Devices, Safety Sign, Consultation with Experts Related to Construction Safety, Others. The safety cost components which has been identified and developed should be validated to the experts. The format table for safety cost structure is also shown in Table 2.

E. Calculation of Safety Cost

In order to achieve the research objective no. 5, calculation of safety cost should base on determined safety cost components and follow calculation method in the Letter of the Minister of Public Works Number 11/SE/M/2019. Safety cost calculation format is shown in Table 3.

V. CONCLUSION

Research and analysis results obtained from this research are:

- 1) Making standardized WBS of cable stayed bridges construction consists of 6 levels, Level 1: Project Name, Level 2: Work Section, Level 3: Sub – Work Section, Level 4: Work Package, (Alternative Methods / Design), Level 5: Activities, and Level 6: Resources. Classification level of WBS standard is set after compiling and analyzing data / archives based on previous research and has been validated by experts.
- 2) Identifying activities potential risks and determining the risk responses or risk controls so that the level of risk can be decreased.
- 3) The development of a safety plan using risk-based WBS standards is completed and developed based on the safety planning document / Regulation of the Minister of Public Works no. 05 / PRT / M / 2014
- 4) Determination of safety cost components should base on the safety plan, then safety cost components are group according to the Regulation of the Minister of Public Works Number 28/PRT/M/2016 and the Letter of the Minister of Public Works Number 11/SE/M/2019.
- 5) Safety cost calculation should follow safety cost components which have determined in the Letter of the Minister of Public Works Number 11/SE/M/2019.

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Table 1. Hazard Identification, Risk Assessment, and Determining Control (HIRADC) Format

WBS Level 5 Activities	Potensial Hazards	Probability	Impact	Risk Rating	Risk Level	Risk Controls
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Table 2. Safety Plan and Safety Cost Structure Format

WBS Level 5 Activities	Potensial Hazards	Risk Controls	Objectives			Program			Safety Cost Components
			Description	Measurements	Duration	Achievement Indicator	Monitoring	PIC	

Table 3. Safety Cost Calculation Format

No	Item Description	Unit	Volume	Unit Price (IDR)	Total Amount (IDR)
A	General Cost				
1	Personal Protective Equipment				
B	Specific Cost				
1	Safety Plan Preparation				
2	Socialization, Promotion, and Training				
3	Working Protective Equipment				
4	Insurance and License				
5	Safety Personnel				
6	Medical Facility, Infrastructures and Devices				
7	Safety Signs				
8	Constultation to Expert regarding Construction Safety				
9	Others				
C	Security Cost				
1	Safety Unit Price Analysis				
i	Total Safety Cost				
ii	Project Amount				
iii	% Safety Cost/Project Amount				