DEVELOPMENT OF STANDARDIZED WBS (WORK BREAKDOWN STRUCTURE) FOR PLANNING THE SCHEDULE BASED ON RISK IN STEEL BRIDGE CONSTRUCTION PROJECTS

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Abstract

Work Breakdown Structure (WBS) is a breakdown of deliverables and project work into smaller components that can be better managed. In fact, bridge construction projects in Indonesia are still many that are not in accordance with the planning in terms of scheduling. Therefore, the development of risk-based WBS Standardization is proposed for planning schedule of Steel Bridge work. The research consists of several stages with qualitative risk analysis method. The results show that WBS standard consists of 6 levels, with the dominant risk variable on project time performance, in which risk responses are recommended to develop standardized WBS.

Keywords
Time, Scheduling, Steel Bridge, Risk,WBS

1. Introduction

A steel truss bridge construction project requires a standard work breakdown structure to ensure that each work package and its existing activities and resources can be defined one by one according to their scope of work. In the third Revised General Specification (2010), there are several divisions that determine the position of an activity in the making of WBS. But the common thing that often happens in the field is the lack of standards in the manufacture of WBS so that the work packages, activities and resource work can not be defined since the planning process leading to miscalculations on specific performance such as cost, time of execution, as well as safety planning work.

On the other hand, WBS is known as the backbone of not only mature planning, but also implementation and control of a project [1]. Steel frame bridge work is one of the high risk category jobs where clear procedures are required in planning and implementation. For example, in the formulation of time performance, planning-related work methods are required, taking into account the risks that may have a negative impact during the construction phase. However, in the absence of WBS standards that take into account risks, project planning becomes unstructured and may lead to errors in cost estimates and implementation schedules in case of planning misidentification. Taking into account the risks of existing field conditions, the work methods outlined in the WBS already contain scheduling estimates, so all types of activities and resources in the work can be identified, so errors in the cost calculation and project schedule can be finalized.

2. Literature Review

Making WBS is a process of describing deliverables and project works in the form of individual components in the form of top down lists and hierarchically explaining the components to be built and the work associated with it. Each of the WBS representes an increasingly detailed work item. WBS is a system that divides the project into manageable work packages, components, or WBS element to provide a common framework for scheduling the scope, costs, allocation of responsibilities, communication, risk assessment, monitoring and control [2].

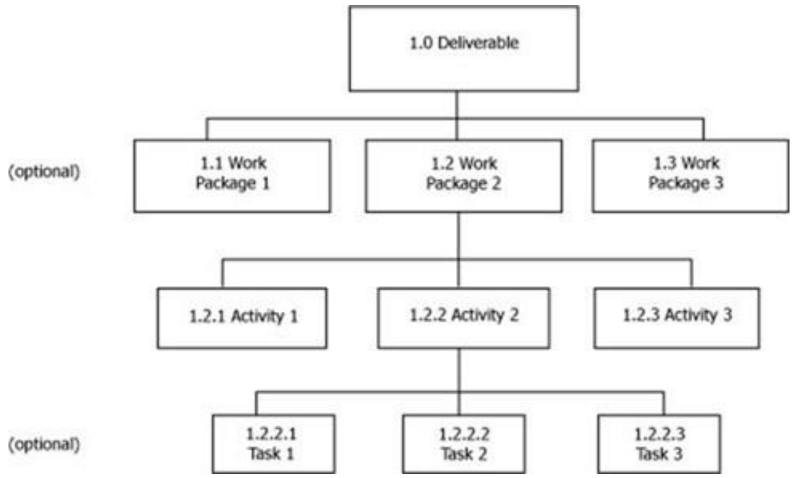

Figure 1. General Format (Classic) WBS, Project Management Institute (2006)

Other sources based on General Specification of Bina Marga 2010 Revision 3 (2014) [3]. WBS road and bridge construction works consist of 10 divisions as follows :

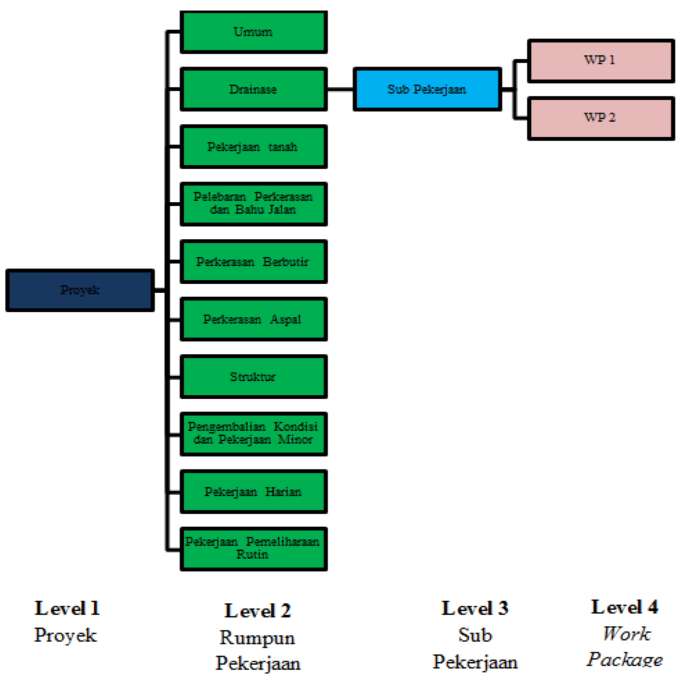

Figure 2. Based on the existing WBS hierarchy of Highways 2010 General Specifications Rev 3

An other sources based on The Special Specification of Freeway and Toll Road 2017 [4] is a Toll Road Minimum Service Standard issued by the Toll Road Regulatory Agency (BPJT) which is used as a basis for toll road development.

3. Research Methodology

In this study, data collection was conducted by archive study and conducted surveys to experts and non experts, expert interviews, and questionnaires of respondents. This study also used statistical analysis using SPSS version 23 to obtain data validation. There are several types of statistical analysis used in this study, such as homogeneity test, validity and reliability test. Risk analysis is used to determine the cause and impact of risks that are incurred as well as the prevention of the highest risk factors with preventive and corrective actions from the results of high risk factor analysis which eventually used as the development of WBS.

4. Data Analysis & Discussion

4.1 WBS Standardization

After analyzing and processing the data based on the comparison of 22 Bridge Projects and 5 toll road projects which are then validated to experts who have worked on steel bridges and toll roads to obtain the representative WBS Standards with 9 groups of work package divisions, we get following figure

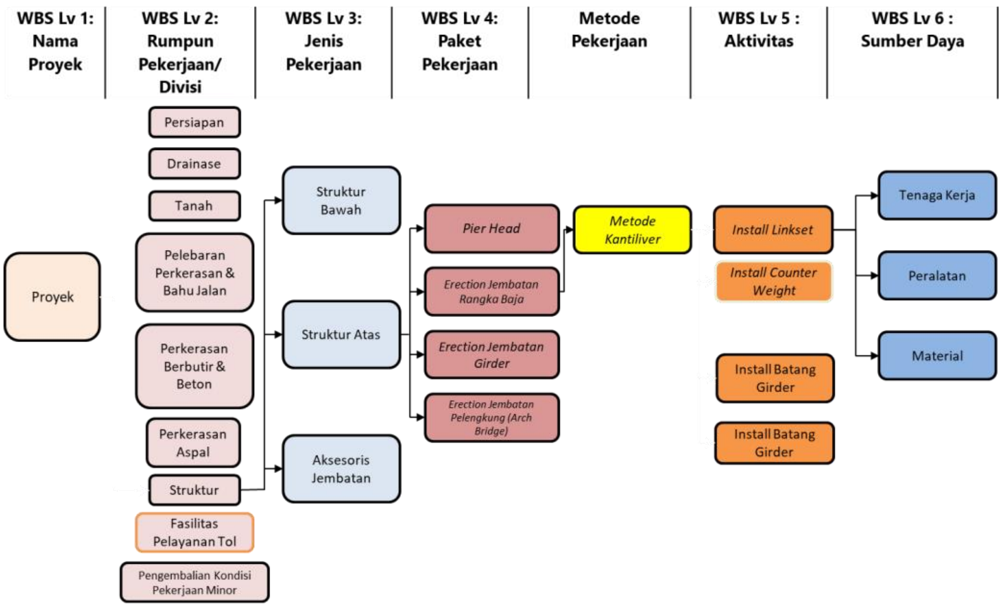

Figure 3. WBS Standar with 6 Level for Steel Bridge

4.2 High Risk Identification

The first phase of the risk analysis is performed by Pareto analysis of 5Example of steel bridge projects in Indonesia, in getting a dominant work package that has an impact on the cost of BOQ. Furthermore, the result of Pareto Analysis to identify the highest risk analysis, divided into several catagories of research :

1) The work package
2) Alternative method
3) Activity
4) Material
5) Equipment
6) Labor
7) Environment.

The highest risk factor affecting the time performance is :

Table 1 The Highest Risk Factor

RISK THAT INFLUENCE PROJECT TIME PERFORMANCE	
WBS RISK CATEGORY WORK PACKAGE LEVEL 4	
X2	The existence of scope changes
X4	Subcontractor productivity is not according to the plan

RISK THAT INFLUENCE PROJECT TIME PERFORMANCE	
RISK CATEGORY ALTERNATIVE METHODS / DESIGN	
X6	Changing of their work method
X7	The applied construction / implementation method is not in accordance to the planning
WBS RISK CATEGORY ACTIVITY LEVEL 5	
X9	Not doing scheduling detailed planning of project activities
X10	Job sequence changes
WBS RISK CATEGORY MATERIALS RESOURCE LEVEL 6	
X12	Late delivery of materials behind schedule planning
X15	Procurement is not in accordance to with the planning elicitation
WBS RISK CATEGORY EQUIPMENT RESOURCES LEVEL 6	
X16	The plan of tool productivity tool is not according to the plan
X17	The amount of equipment is held less than planning
WBS RISK CATEGORY LABOR RESOURCES LEVEL 6	
X21	The number of workers is not based on planning
X24	Labor productivity lower than planned
WBS RISK CATEGORY ENVIRONMENTAL RESOURCES LEVEL 6	
X28	Disruptions (demonstrations) from the community hamper the implementation
X29	Unpredictable weather (high tide) during the implementation of erection

4.3 WBS Development based on High Risk

Based on the dominant risk variables, the next step in this research is to determine preventive measures, correctives, causes and impact of the risk event. A number of measures that have been validated by expert are a response to risk that can be grouped into five input formula in the development of the risk-based WBS. which are:

Table 2 WBS Development based on Highest Risk Factor

RISK THAT INFLUENCES PROJECT TIME PERFORMANCE		RESPON RISK
WBS RISK CATEGORY WORK PACKAGE LEVEL 4		
X2	The existence of scope changes	Additional job requirements (RKS or Technical Specification)
X4	Subcontractor productivity is not according to the plan	Additional management
RISK CATEGORY ALTERNATIVE METHODS / DESIGN		
X6	Changing of their work method	Additional management
X7	The applied construction / implementation method is not in accordance to the planning	Additional job requirements (RKS or Technical Specification)

RISK THAT INFLUENCES PROJECT TIME PERFORMANCE		RESPON RISK
WBS RISK CATEGORY ACTIVITY LEVEL 5		
X9	Not doing scheduling detailed planning of project activities	Additional management
X10	Job sequence changes	Additional management
WBS RISK CATEGORY MATERIALS RESOURCE LEVEL 6		
X12	Late delivery of materials behind schedule planning	Additional other WBS
X15	Procurement is not in accordance to with the planning elicitation	Additional other WBS
WBS RISK CATEGORY EQUIPMENT RESOURCES LEVEL 6		
X16	The plan of tool productivity tool is not according to the plan	Additional management
X17	The amount of equipment is held less than planning	Additional management
WBS RISK CATEGORY LABOR RESOURCES LEVEL 6		
X21	The number of workers is not based on planning	Additional management
X24	Labor productivity lower than planned	Additional management
WBS RISK CATEGORY ENVIRONMENTAL RESOURCES LEVEL 6		
X28	Disruptions (demonstrations) from the community hamper the implementation	Additional management
X29	Unpredictable weather (high tide) during the implementation of erection	Additional management

5. Conclusions

From the obtained research results it can be concluded that:

1) Results of WBS standard ssteel bridge consisting of 9 divisions, among others
    a. Division 1- The preparation work
    b. Division 2- Drainage work
    c. Division 3- Land work
    d. Division 4- Pavement works and shoulder widening
    e. Division 5- Grained pavement and cement concrete pavement
    f. Division 6- Asphalt pavement
    g. Division 7- Structural work
    h. Division 8- Toll service facilities
    i. Division 9- Returns of Public minor conditions work
2) The 14 highest risk factors along with the causes, impacts, preventive and corrective actions of the stages of the dissemination of questionnaires and validation of related experts

3) From the final validation results by the expert, the preventive and corrective actions taken from an activity with high risk factors to develop the risk-based WBS standard against time performance, then the 14 highest risk factors that have been verified by the expert got some WBS development input formulated as follows:
    a. Additional management
    b. Additional other WBS
    c. Additional related WBS
    d. Additional job requirements (RKS or Technical Specification)
    e. Influencing WBS coefficients

References

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Biographies

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Yusuf Latief is a professor and currently a fulltime senior lecturer in University of Indonesia. He was born in Jakarta, 7 March 1960. Mr.Yusuf Latief got his Bachelor of Civil Engineering, Master of Civil Engineering, and Doctoral of Civil Engineering degree from University of Indonesia. Now He teaches for Undergraduate, Graduate and Doctoral Programs. He actively writes articles in national and international journals with specifications in the areas of Project Management and Construction.