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Development of WBS (Work Breakdown Structure) Risk Based Standard for Planning Cost Estimation at Port Project

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Abstract. The planning of a Work Breakdown Structure project is inevitable, because WBS is the initial stage of project management that divides the activities into small work packages making it easy to manage. While the nature of a project is unique, it basically has elements of construction work that are relatively similar for the same project, so standardizing of the work is possible. The existence of standardization will speed up the project planning process and will reduce costs during the project planning period. This research has a goal of developing WBS standardization on port projects and identifies risks that may occur during project implementation and consider them in the cost estimation process. Risks are obtained from the perspective of the contractor as the project implementer. The study is limited to port construction projects. The data collected came from a questionnaire survey to experienced contractors on a port construction project. The results of this study are expected to help the contractor on the estimated costs to be able to know and anticipate the risks that may occur during the implementation of the port construction.

1. Introduction

About 90% of Indonesian trade at home and abroad depend on sea transportation as a means of distribution. There are about 1,241 ports in Indonesia that are commercial or non commercial. Based on data on the number of islands in Indonesia that there are as many as 18,110 islands, it can be said that 1 port serves 14 islands with an average area of 1.548 km² / port. This condition is certainly not balanced compared with other countries in Asia [2]. Given the importance of port development, careful planning is required before project implementation. The success of a project's management will largely depend on the ability of the project manager to specify the work package in terms of products and activities. WBS becomes one of the major tools for planning and controlling work packages. In general WBS is used at the beginning of the project to determine the scope of the project, estimate cost and scheduling [7].

The viability of a project depends on the accuracy and ability to estimate project costs during the planning period. During the planning period, generating accurate estimates is generally difficult due to the lack of information available [9]. By applying WBS standardization will be obtained cost and time savings on project planning process such as cash flow forecasting, resource allocation and cost estimation and more accurate scheduling [1]

2. Research Objectives

The objectives of this research are :

1. To obtain a standard form of WBS port construction project



2. To identify the working methods in each work package on the port construction project
3. To identify the activities in each port project construction work package
4. To identify the resources used of each port project construction work activity
5. To identify risks in each package of work, activities and resources that affect the cost performance of port project work
6. To develop a WBS standards of port construction project for risk-based cost estimation planning

3. Literature Review

3.1. Work Breakdown Structure (WBS)

WBS is a hierarchical decomposition of the entire scope of work that serves to achieve project deliverables. The deliverable is a unique product / outcome that must be obtained to fulfill the process, phase, or project steps. Generally used for reference to external deliverables as subject of approval of sponsor or owner. WBS sets and determines the total scope of a project. Each lower level within the WBS, this shows a higher level of detail for each job on the project [7]. WBS is the basic form of many project management processes. Although each project is unique and different, WBS on such projects can be standardized and used as a basis for universal construction work. Standardization of work will speed up the planning process and can also reduce cost management [4]. The preparation of WBS uses expert judgment and decomposition. Decomposition is used to divide the project scope into smaller and more manageable so-called work packages [8].

3.2. Risk Management

Project Risk Management is a process that includes, plans for risk management, identification, analysis, response plans and risk control in a project [7]. Risk management is an important part of the process of making decisions on construction project management, especially in terms of integration, scope, quality, cost, time, communication, human resources and procurement. Using RBS (Risk Breakdown Structure) can help improve the ability to identify uncertainties and possible risks [10]. Risk Management is a formal process by which risk factors are systematically identified, analyzed and addressed. In dealing with risk, there are four stages of the process that must be done [3]:

- Risk identification, is to observe conditions, identify and clarify potential risk events
- Risk analysis, is to determine the likelihood of occurrence of a risk and its consequences
- Risk response, is an action that is a strategy to tackle the risks that may arise
- Lesson learned, is to summarize any analysis, findings and lessons learned in managing risk for the foreseeable future

3.3. Cost Estimation

Cost estimation is the process of developing the approximate monetary resources needed to complete the project activity. The main benefit of this process is that it determines the amount of costs needed to complete the project work. Cost estimates include the identification and consideration of alternative costs for initiating and completing projects, costs are sacrificed and risks should be considered such as making compared to buying, buying rather than leasing, and sharing of inner resources to achieve optimal cost for the project. The estimated cost for all resources to be charged to the project is not limited to labour, materials, equipment, services, and facilities, as well as special categories such as inflation, financing costs, or contingency costs [8].

In essence, cost estimates involve the application of techniques that transform technical information and programs that are measured into financial and resource information. The outputs of the estimates are used primarily as inputs for business planning, cost analysis, and decisions for project costs and schedules [6].

4. Methodology

This research used a qualitative approach to obtain the formulation of WBS standards for a port construction project. Using bill of quantity data from 19 port projects. Then a survey and a deep interview to experts who have more than 20 years experience in port construction project. After obtaining the WBS standard, the next process is to identify the risks of each work package, activity, materials, equipment, and labour of WBS standard.

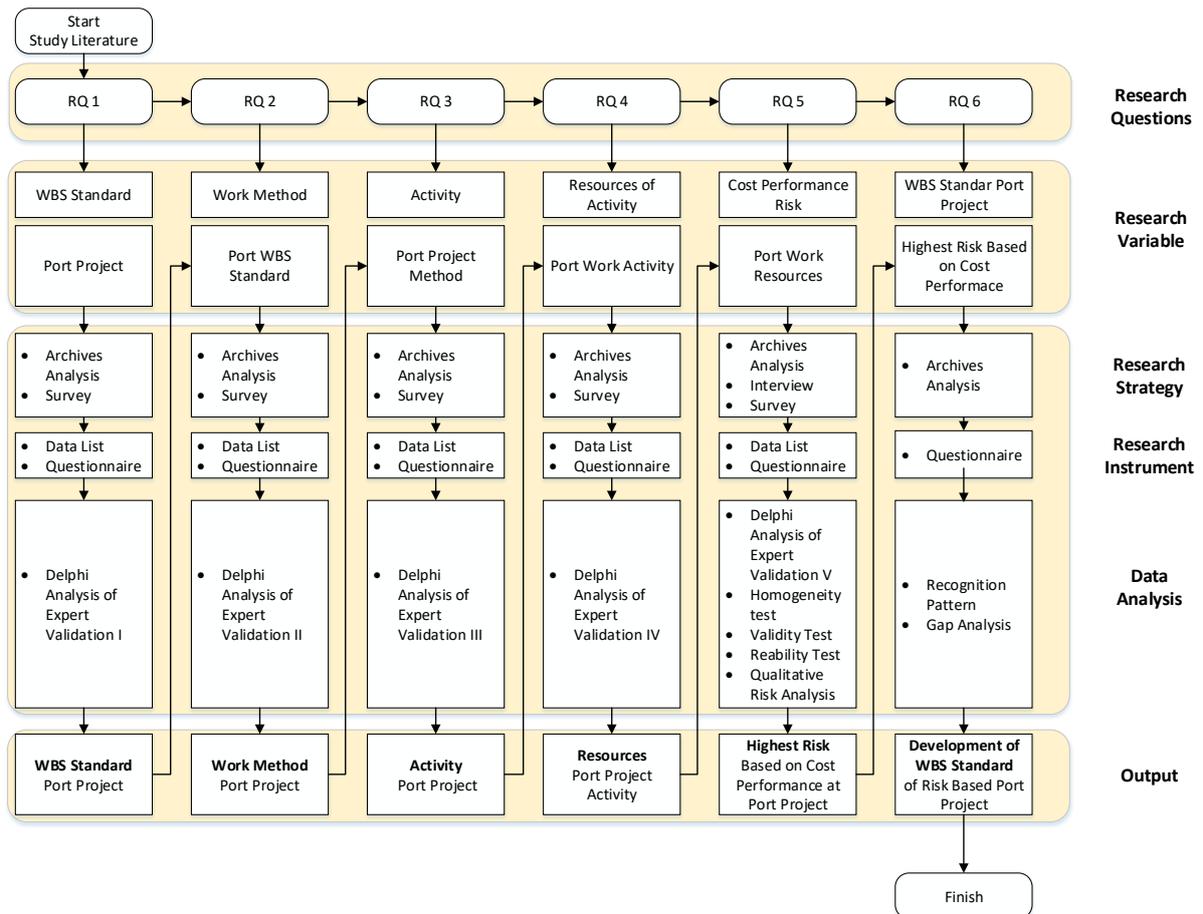


Figure 1. Flowchart of Research.

5. Result & Discussion

5.1. Standarization WBS of Port Project

Based on the literature review, data of the previous port project and and then validation by port experts, it is found that the port project is divided into 9 (nine) occupations: preliminaries, docks, trestle, dredging, causeway, container yard, facility buildings, mechanical electrical, and breakwater. The division of the project at the port can be seen in figure 2 below :

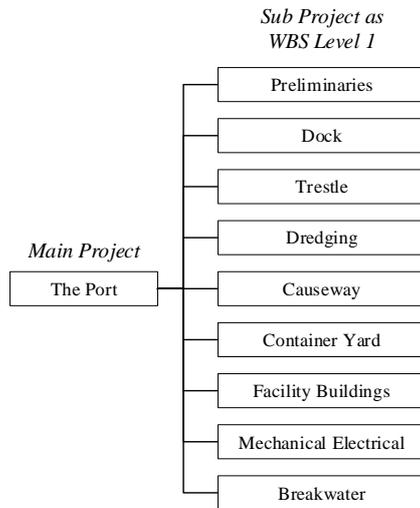


Figure 2. The sub-project on the main project (the port) becomes WBS level 1, there are preliminary, dock, trestle, dredging, causeway, container yard, facility buildings, mechanical electrical and breakwater.

Then the level 1 in WBS will then be divided into the smallest part called the work package. But to make the work package more detailed, because of its effect on cost estimates. So, the work package will be divided into activities and resources. Chart of division of WBS level can be seen in figure 2 below:

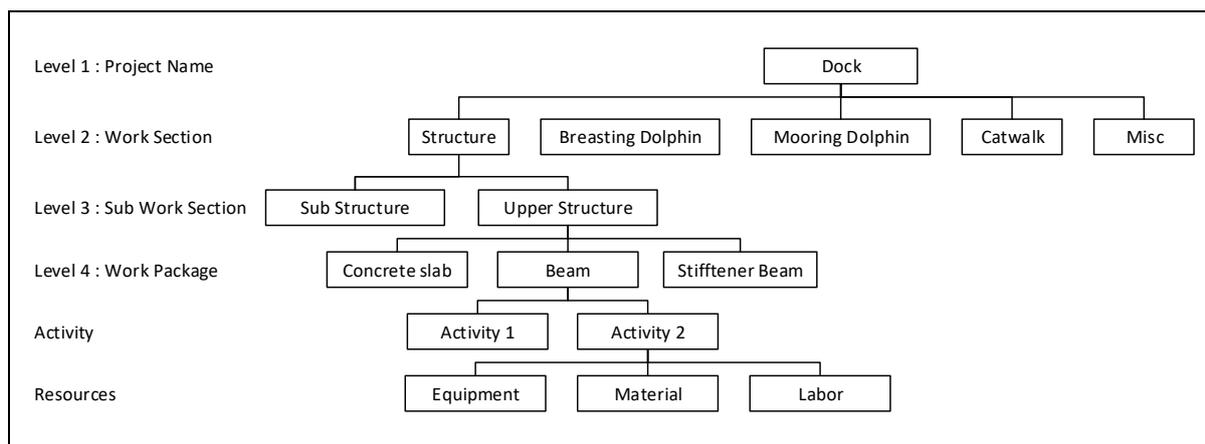


Figure 3. WBS for Dock’s Construction at Port Project.

WBS level 1 is the project name of the dock. Level 2 is a work section of structure, breasting dolphin, mooring dolphin, catwalk and misc. Level 3 is sub work section in the form of upper structure and sub structure. Level 4 is a work package in the form of concrete slab, beam and stiffen beam. Level 5 is an activity and level 6 is a resources (equipment, material and labour).

5.2. Development of WBS Standar Based on Risk

Identification of risks to port construction projects that may affect cost performance derived from literature studies, then clarification and validation by experts. Once the scale of probability and impact is obtained, the risk score can be calculated by:

$$R = P \times I \tag{1}$$

Where R = Risk Factor, P = Probability and I = Impact

Based on the results of a survey of several respondents and then the results were validated by experts. From the results of 37 number of identified risk events, then we get 10 risks with the highest rank that can affect the cost performance of the port project, the results can be seen in the table below:

Table 1. Rank of Risk Event.

Rank	Risk Event	Category
1	High sea waves	Environment
2	Material usage exceeds the required volume	Material
3	Qualifying labor is not according to plan	Labour
4	Errors of equipment productivity estimates	Equipment
5	Error calculate the volume of work	Work Package
6	Underwater conditions differ from the assumption of tenders	Environment
7	Error predicting weather and events	Environment
8	The price of material purchased exceeds estimates in planning	Material
9	Procurement of labor for implementation is not in accordance with needs	Labour
10	Tides occur	Environment

After getting the risk value, then the analysis to get the risk response in the form of preventive and corrective action. These risk responses will be added in compiling the WBS at level 4 (work package), level 5 (activity) and level 6 (resources) as a development of WBS standarization in this research.

6. Conclusion

Based on the standard WBS manufacturing process it can be concluded that the port construction project is categorized into 9 (nine) projects, namely preliminaries, dock, trestles, dredging, causeway, container yard, facility buildings, mechanical electrical and breakwater. The standard WBS project port for each category is divided into 6 levels, Level 1: Project Name, Level 2: Work Section, Level 3: Sub Work Section, Level 4: Work Package, Level 5: Activity and Level 6: Resources.

Identification of risks that may affect cost performance based on 6 (six) groups ie work package alternative method / design, activity, material, equipment and labor. 10 highest risk obtained are carried out risk response. The result of the risk response is added to a new activity in the standard WBS that has been created.

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