Time and cost analysis of jacket structure load out using skidding

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Abstract. This paper conducted an analysis to determine time and cost required in the jacket structure loadout process using skidding method. Determining normal time and cost in accordance to the company’s budget for jacket structure loadout process using skidding with CPM. The purpose of this paper is to obtain project schedule with low cost using skidding with CPM to determine the time and cost needed for the jacket load out. The analysis result of time and cost by CPM for jacket structure loadout process using skidding is 9 days with a total cost US$ 68,196.

Keyword: Cost, Project, Schedule, Load Out

1. Introduction
Indonesia is one of the oil and gas producing country, where its oil and gas resources found in the ocean which is 70% of Indonesia’s territory. Thus, offshore infrastructure to facilitating oil and gas exploration and exploitation activity must be built. Structure that usually built for oil and gas exploration and exploitation activity is offshore platform, which the common platform is fixed platform/jacket platform. Offshore platform is constructed by the offshore fabricator company. Prior operation, offshore platform must be transported from yard to barge, then it will be delivered to the site where it would be installed. This transportation process is called loadout. Loadout process needs technical and cost planning in order to control production costs and technical aspect. For this paper, time and cost analysis will be conducted for the loadout jacket structure using skidding method.

1.1. Loadout of jacket structure
Jacket Platform is a construction for oil and gas drilling and producing activity. In general, jacket platform has two essential parts [1]:
\begin{itemize}
\item Jacket, as a construction for pilling, which stands from seabed to the sea surface.
\item Deck (upper structure), as a construction built and assembled above the pile of jacket.
\end{itemize}

Jacket is welded tubular joint construction, which is it will be legs of platform. Jacket has 3-16 legs, depend on the size of platform. Jacket construction fixed from seabed until sea surface with pile foundation made from iron pipe.

Loadout process is divided into 4 methods [1]:
\begin{itemize}
\item Lifting Method: lifting the structure using a crane to barge.
\item Skidding Method: transport the structure above skid way to barge. Skid way is constructed 90 degree with jetty.
\end{itemize}
• Multiwheel Method: transport the structure using a multiwheel hydraulic trailer or SPMT, which it has advantage can be transport from all location because not attach with skid way.
• Float away Method: The structure is self-floated by its own buoyancy then pulled by tug boat, such as submersible hulls, TLP hulls, and FPSO hulls.

1.2. CPM & PERT
Critical Path Method (CPM) is a mathematic model for calculate the fastest time from the beginning of project until finished [2]. Critical Path consists of critical activity sequences, from first step until completion of the activity [3].

Program Evaluation and Review Technique is a method for decrease project delay, to coordinate and synchronize project activity to accelerate the project completion [4]. The essential part of PERT consists of :
• Optimistic Time ( To )
Time Estimation has a small possibility to be completed. The possibility is one of a hundred.
• Most Likely Time( Tm )
Time Estimation describes the most possible time to complete an activity, if the activity occurred repeatedly in the same condition.
• Pessimistic Time(Tp )
Time Estimation has a smallest possibility to be completed. The possibility is one of a hundred.

To, Tm, and Tp is used to calculate normal activity. Weather, for example, an activity that is affected by weather condition, needs to be learned about a general weather that occurred in certain year and make suitable consideration to estimate To, Tm, and Tp.

After the three time estimation has been made, the estimation must be combined into one value. Calculation of the value is done by algebra with using average time. It is called Expected Time(Te), time needed to complete an activity.

Average time or Expected time can calculate with equation:

\[ T_e = \frac{T_o + 4T_m + T_p}{6} \]  

Where:
- Te = Expected Time
- To = Optimistic Time
- Tm = Most Likely Time
- Tp = Pessimistic Time

To describe the variation or dispersion of activity in network planning PERT, standard deviation is used, then standard deviation and variances for certain activity can be calculated [5]. Most likely time (Tm) is not affecting the standard deviation calculation, though affect by optimistic time (To) and pessimistic time (Tp) [6].

Standard deviation and variances can be calculated in critical path until last event. If more than one critical path, variances which used is amount of variances in critical paths. Because critical path has a probability, can be assumed total distribution of project duration is nearly Normal Distribution.

Probability of project completion ( Tx ) can be calculated by:

\[ Z = \frac{T_x - T_{et}}{\sigma_D} \]

This equation is needed for find the probability estimation using Normal Standard distribution [7].

2. Research Methodology
This paper uses CPM method for finding critical path from work breakdown structure. Completion of loadout process using skidding with CPM method. After calculating completion time, so project cost can be estimated. In order to calculate probability of completion time loadout process using skidding, PERT method can be used. Firstly, determine the three estimation of completion time. Secondly,
combine the three estimation into one value and calculate the standard deviation and varian.

3. **Data Analysis**

This paper is trying to analyze time and cost of skidding method. Table 1 shows Jacket X specification with skidding method.

| No. | Item   | Description |
|-----|--------|-------------|
| 1   | Tonnage| 810 ton     |
| 2   | Leg    | 4 legs      |
| 3   | Depth  | 24 m        |

Table 1. Jacket X tonnage.

Jacket will be pulled from fabrication area to barge above skid way track as illustrated in Figure 1.

![Figure 1. Illustration for Skidding Method](image)

**Source:** [8]

3.1. *Time calculation of loadout process*

Time calculation of Jacket X loadout process using Skidding Method is described in Figure 2.

![Figure 2. Critical path of Jacket X loadout process found by CPM method in line:1-2-3-4-5-6-7-8.](image)

Table 2. Loadout activity of Jacket X using skidding method.

| Symbol | Activity                               | Duration(days) |
|--------|----------------------------------------|----------------|
| A      | Barge preparation and loading loadout material | 1              |
| B      | Welding skid beams and install dead man  | 2              |
| C      | Pitching turn and Install Mooring       | 1              |
Symbol | Activity | Duration(days)
--- | --- | ---
D | Onshore Skidding | 1
E | Load out Jacket | 1
F | Sea fastening and Remove all loadout facilities | 2
G | Sail Out | 1

### 3.2. Cost Calculation of Jacket Loadout Process

Cost Calculation of Jacket X loadout process using skidding method is tabulated in Table 3. Total cost loadout process can be calculated with adding up worker cost and equipment rent cost.

**Table 3. Worker cost of Jacket X loadout process using skidding method.**

| No | Activity Description | Cost (US$) |
|---|---|---|
| 1 | Barge Preparation and Loading Loadout Material | 6,128 |
| 2 | Welding Skid Beams and Install Dead man | 6,256 |
| 3 | Pitching turn and Install Mooring | 1,984 |
| 4 | Onshore Skidding | 6,256 |
| 5 | Loadout Jacket | 4,776 |
| 6 | Sea fastening | 3,616 |
| 7 | Sail Out | 680 |

**Total** | **29,696**

From this calculation, worker cost of Jacket X loadout process during 9 days is US$ 29,696.

**Table 4. Equipment rent cost of Jacket X loadout process using skidding method.**

| No | Name | Unit | Duration (day) | Daily cost (US$) | Total Cost (US$) |
|---|---|---|---|---|---|
| 1 | Tug Boat | 1 | 7 | 2,500 | 17,500 |
| 2 | Barge | 1 | 7 | 3,000 | 21,000 |

**Total** | **38,500**

From this calculation, equipment rent cost of Jacket X load out process is US$ 38,500.

Total Cost = Worker cost + Equipment rent cost

= US$ 29,696 + US$ 38,500

= US$ 68,196

So, total cost of Jacket X with load out process using skidding method during 9 days is US$ 68,196.

### 4. Conclusion and Suggestion

The conclusions of this paper are:

a. Completion time for Jacket X with loadout process using skidding method is 9 days.

b. Total cost for Jacket X with loadout process using skidding method is US$ 68,196.

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