Identification of variables causing delays to turnaround maintenance project

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Abstract. Maintenance activities or turnaround maintenance that exceeds the specified time, and unscheduled shutdown or unplanned shutdown events are factors that cause production loss and reduce the company's profit potential which ultimately leads to losses for the company. This research aims to Identify the current turnaround maintenance planning process contributed to the extension of the duration of the turnaround maintenance work, Identifying methods to shorten the duration of turn around maintenance and developing methods to optimize turn around maintenance work so that turn around maintenance work can be carried out effectively, according to the planned time and with good quality. Qualitative risk assessment is being carried out based on turnaround maintenance project reports from previous turnaround maintenance projects and expert judgment are used to ensure risks are identified, analysed and mitigated. Risks are ranked by their likelihood and severity that may cause delays to projects. Methods to shorten duration and recommendations are raised to ensure effective turnaround project. The research was conducted in a fertilizer company PT XYZ.

1. Introduction

The purpose of turnaround activities is usually to carry out maintenance such as inspection and repair of equipment. Turnaround activities are also an opportunity to replace worn or damaged process materials and equipment that have reached their useful life. Both of these activities restore the asset base life cycle and ensure safe and efficient operations between TA activities. Often this work can only be done when the processing / production unit is not operating [1]. Plant turnaround (TA) is an essential activity of any continuous process plant [2] with the aim of invigorating, sustaining, and increasing plant performance [3]. Plant TA is necessary because equipment or part of equipment have limited life span in comparison to the plant.

Project completion at the designated time is the target for each business entity [4]. Delay is not acceptable because the delay will cause large losses including production losses. Each activity has an inherent time factor and every delay in each of these activities will accumulate into a large delay if not monitored properly [4]. Successful projects are defined as projects that achieve their objectives in terms of scope of work, within the specified schedule and budget. In many cases, the budget is compromised to achieve results at the specified time [4]. The faster an organization completes projects, the faster the organization can get the results it wants [4].

Activity defining, determining sequences and estimating duration in turnaround projects are very dynamic. Due to the dynamic turnaround project process, different methodologies are needed to achieve...
project success. Planning activities that are too wide is one of the obstacles using scheduling that is usually done on construction projects or EPCs. According to Ertl, 2005 in Obiajunwa this is due to [5]:

- Turnaround project schedules are difficult to estimate with a high level of confidence
- Work details can be disguised so that they are ignored by planners
- Work on the turnaround management project must include a critical path detail analysis where further details need to be considered in perfecting the critical path
- It is difficult to make accurate progress estimates where estimating the percentage of work completed is more difficult.

This research aims to identify the current turnaround maintenance planning process contributed to the extension of the duration of the turnaround maintenance work, identifying methods to shorten the duration of turnaround maintenance and developing methods to optimize turnaround maintenance work so that turnaround maintenance work can be carried out effectively, according to the planned time and with good quality. Qualitative risk assessment is being carried out based on turnaround maintenance project reports from previous turnaround maintenance projects and expert judgment are used to ensure risks are identified, analysed and mitigated. Risks are ranked by their likelihood and severity that may cause delays to projects. Methods to shorten duration and recommendations are raised to ensure effective turnaround project.

2. Methods

This research aims to identify variables causing delays to turnaround maintenance project conducted in PT XYZ subsidiaries. Time variable serve as the dependent variable or the affected variable in question is the turnaround project performance in terms of time, while the following serve as the independent variable or influencing variable, namely (1) Planning: Turnaround project work planning which includes the following work items, namely:

- Planning the scope of work
- Planning work scheduling / scheduling and determining critical path
- Planning the procurement of goods and services
- Human resource planning and competencies that need to be had

(2) Risk variable: The identified negative / threat risks can hamper the work of the identified turnaround project at the time of risk identification.

Archive analysis from previous turnaround maintenance project close out report, Plant Audit Report, and risk identification from expert judgment is carried out. Turnaround Maintenance Project Close Out Reports, minutes of meetings, and other organizational documents obtained from turnaround maintenance projects done from 2014 to 2019 from 5 PT XYZ subsidiaries were collected as case studies to determine the following:

- Delays during the turnaround and maintenance project
- Costs caused by the delays
- Causes of the delays
- Recommendations from the project teams.

Interviews are conducted to 2 personnel having more than 5 years’ experience and to 4 personnel having more than 15 years’ experience within the company and having experienced as member of the turnaround and maintenance projects. Interviews are meant to determine risks associated with turnaround maintenance projects and conducting qualitative risk assessment for turnaround project.

3. Results and discussion

Table below show the delay of turnaround maintenance project conducted annually. There is an average of 1 to 2 turnaround maintenance project annually in every subsidiary. Target to be achieved for turnaround projects are:

- Turnaround maintenance project to be completed in shorter duration.
• The time interval between turnaround maintenance project for the same facility is longer.
• Turnaround maintenance costs to be reduced by 25% -30%.
• The volume of loss of products to be reduced by 25% -30%.
• Improve plant reliability.

Turnaround maintenance project close out reports from 22 turnaround maintenance conducted from 2014 to 2019 shown that there is an average of 24,77 days of delays for every turnaround maintenance projects conducted.

Table 1. Scheduled shutdown delay (days) in ammonia and urea plant due to turnaround maintenance project.

| Scheduled Shutdown Delay (Days) - Ammonia and Urea Plant | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---------------------------------------------------------|------|------|------|------|------|------|
| PT A                      | No TAM scheduled | 6,19 | 5    | 120,25 | 7,89 | No TAM scheduled |
| PT B                      | No TAM scheduled | 6,7  | 5    | No TAM scheduled | 5,31 | 8,69 |
| PT C                      | 1,5  | No TAM scheduled | 13 | Project on time | 9 | 1,5 |
| PT D                      | 6    | Project on time | No TAM scheduled | 161,68 | 83,21 | 5 |
| PT E                      | 16   | No TAM scheduled | 47 | No TAM scheduled | 36 | No TAM scheduled |
| Total Days                | 23,5 | 12,89 | 70   | 281,93 | 141,41 | 15,19 |

Data collected from turnaround maintenance project close out reports from 22 turnaround maintenance project shown that the cause of the delays are mostly caused by additional scope of work during the project execution.

Figure 1. Occurrences causing delays to turnaround maintenance project.
Additional scope is the most occurrences causing delays in turnaround maintenance projects. For example, as described in Plant Audit Report Document conducted in 2019 in PT D shown that The number of additional Work Orders during Fiscal Year 2018/2019 was 38 WO (6%) of the total planned 653 WO. Material readiness to support work is as low as 61.73%.

Plant Audit Report Document conducted in 2019 in PT C shown that there are still many additional jobs after the freeze date. Work added after the freeze date requires faster planning so that if critical materials are needed it is feared that the parts cannot be expedited until the turnaround maintenance project time. The addition of work when the turnaround maintenance project has gone through a procedure where the authority to add items must obtain the approval of the turnaround maintenance project manager.

Lesson learned from close out report from PT A close out report No. 18, 2nd Plant, 2017 shown that Delay in the arrival of consumable materials and consumable tools that were planned before the Turn around and the material requirements that were known after the inspection also caused delays because they had to wait for the process of purchasing materials as well as some shutdown items / turnaround from other factories so that material was partially unavailable.

Risks are identified and rated by carrying out interviews to experts, for this paper author interviewed 4 personnel with more than 15 years’ experience in turnaround maintenance project and 2 personnel with more than 5 years’ experience in turnaround maintenance project.

It was found that the following is the 10 highest rated risks that may affect time performance of the turnaround maintenance project (table 2).

| No. | Risk Item                                | Probability | Severity | Risk Ranking | Risk  |
|-----|------------------------------------------|-------------|----------|--------------|-------|
| 1   | Delay of material                        | 2           | 4        | 8            | High  |
| 2   | Additional scope during project execution | 2           | 3        | 6            | Medium|
| 3   | Additional scope due to inspection result | 2           | 4        | 8            | High  |
| 4   | Procurement and logistics issue          | 2           | 4        | 8            | High  |
| 5   | Inadequate human resources availability  | 2           | 4        | 8            | High  |
| 6   | Inadequate human resources competency   | 2           | 4        | 8            | High  |
| 7   | Inadequate resources                    | 2           | 4        | 8            | High  |
| 8   | Weather issue                           | 2           | 3        | 6            | Medium|
| 9   | Safety requirements not fulfilled        | 2           | 4        | 8            | High  |
| 10  | Environmental requirements not fulfilled | 2           | 4        | 8            | High  |

Those risks are considered high as the risk may affect the time and quality of the project result. Poor quality may result in rework that will eventually result in more delays to production.

4. Conclusion

Turnaround projects have a high risk because the scope of work is only partially known. More business possibilities that might exceed estimates and not meet expectations need to be anticipated. The possibility of additional work occurring from the results of inspections or when tools are inspected, cleaned or opened becomes a challenge that need to be considered as a risk that needs to be taking in to account. sources of risk in the turnaround project include last minute changes to shutdown, required staff not available, delays in delivery of critical spare parts, worker strikes, picket related information, materials sent at shutdown, weather, work accidents, sabotage, design errors, lack of experience, misunderstanding, mis estimation, poor communication and contractor financial problems.
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