Shorten Lead Time of the Procurement Process in Aluminium Smelter

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Abstract. Aluminium Smelter as a specific manufacture, certainly has various types of needs both in terms of materials, services and spare parts. This difference causes longer duration of procurement lead time which can cause disrupted production processes. Procurement Department as a department that serves the purchase request identifies the source of the problem that causes the procurement lead time process does not meet the standard lead time 45 working days for goods & 60 working days for service. By using Ishikawa's Fishbone and Fault Tree Analyst, it was found that one of the causes of the long lead time of the procurement process was policy. Improvements were made in various aspects such as changes in procurement methods, authority, etc. In the 2019 SKDIR Procurement regulatory application, improvements in goods lead time which were originally from 88.54 working days to 61.90 working days and services from 105.9 working days to 52.62 working days.

1. Introduction
Challenge that all companies are facing today to become global company is how to implement strategies decision and aim for competitive advantages. Today’s market has become volatile and dynamic so all companies must follow all the changes in market or else it will die. Companies require small lead times, low costs and high customer service levels to survive. The result most of companies attempted to reduce lead times, costs and increase customer service levels. Achieving high level of service level will lead to reduce lead times and costs.

Lead time can generally be defined as the time period between the initiation of a task and its completion [1]. More precise definitions depend on context. For example, in the new product development area, lead time is conceived in terms of the time it takes to identify a market need, design and test the product, and develop the pro-cases for manufacturing [2]. Most of companies review lead time in manufacturing, supply chain management, and project management in all stages [3]. By comparing results against established benchmarks, they can determine where inefficiencies exist.

The only one Indonesia Smelter was established in 1976 and a company that builds and operates the Asahan Project. As the only one Aluminum Manufacture in Indonesia certainly has various types of needs both in terms of materials, services and spare parts. On time delivery of the materials, services and spare parts will affect the maintenance schedule and production. It will also affect production and revenue. Such a network of activities is known as supply chain management, so it must be maintained for continuity of the chain.

One of the entities in the supply chain is procurement, procurement has a cascading effect on an organization's bottom line. Procurement includes sourcing and purchasing and coves all of the
activities involved in the product/service sourcing, purchasing and delivery from supplier to the customer [4]. It is a very important activity in manufacturing supply chain as purchased parts and materials account for over 60% of the cost of finished goods. Purchase there exists a general tendency of pushing added value towards outsourcing [5]. Although in the majority of companies this tendency causes the share of material costs and external services to increase, purchasing departments are still largely operations as traditional mid-size order department and not as modern procurement management units. Therefore, the potential of optimizing the purchasing system and hence improving the profit margins is often neglected.

As an the only Aluminium Smelter in Indonesia, the company is concerned about change and wants to adjust to market developments, therefore one of companies’ concern is how optimizing the purchasing system and hence improving the profit margins. Procurement Department is a department that processes all the procurement process in the company. As a single department that meets all needs in company, Procurement Department has agreed to complete its work effectively and efficiently. Eventually, Procurement Department conducted accelerating of the procurement process.

2. Problem Outline

As a procurement department that functions to carry out purchasing duties for the entire goods or service in company, there are various problems arise and the biggest one is relatively long lead time of procurement. Based on the data obtained, the procurement lead time in the company currently does not meet established standards, including:

| Categories  | Standard Lead Time | Year          |
|-------------|--------------------|---------------|
|             |                    | 2019 | 2018 | 2017 | 2016 |
| Goods       | 45                 | 88.54| 102.99| 83.88| 113.36|
| Services    | 60                 | 105.9| 101.57| 101.17| 82.24|

As data the data obtained, the average lead time in Procurement Department does not meet the standard lead time and this can lead to the further problem such as delayed maintenance schedule which can cause the production line to not operate optimally and this condition will decline the production amount. The declining production amount will cause company lose the potential income.

3. Methodology

The methodological used to find out the root cause of the length of procurement lead time using various tools.

3.1. Sampling Method

Purposive sampling is a non-random sampling technique where the researcher determines sampling by determining specific characteristics that are relevant to the purpose of the study so it is expected to answer the research problem.

3.2. Problem Identification

3.2.1. Fishbone. Fishbone analysis (or Ishikawa) is a structured approach that allows a more detailed analysis to find the causes of a problem, discrepancies, and existing gaps. There are several steps to use fishbone analysis. The steps is data collection, describe the cause factor chart, the identification of the problem roots, and recommendations and implementation.

3.2.2. Fault Tree Analysis. Fault Tree Analysis (FTA) is an analysis used to determine the root cause of a potential failure that occurs in the system so the efforts can be made to reduce the defective product. This method is top-down which means it starts as an assumption of failure at the top event
detailing to basic failure. In other words, this method is to look for problems that start from the assumption of a peak event in great detail to get to the root of the basic problem. The steps in the Fault Tree Analysis (FTA) method are as follows [2]. Determine the most important event;

- Set FTA limits;
- Check the system to understand how the various elements relate to one another and the very top event;
- Create a fault tree, starting with the top event and working downward;
- Analysis of the fault tree to identify ways to eliminate events that lead to failure;
- Prepare a corrective action plan to prevent failure.

3.3. Solution Method
The solution method uses a qualitative method which aims to summarize the procurement process. Solution method that use is expert judgement and the points of change that must be done by improving the main factors of the problem.

4. Study Case

4.1. Initial Data Collection
Length of a purchasing process at Procurement Department is measured using standard lead time. Lead time is a measure of time that shows how long a Procurement Department received an order called Purchase Requisition (PR) to become a contract (Purchase Order / PO).

![Flow Process](image)

**Figure 1.** Procurement stage from procurement plan to delivery

Lead time that used by Procurement Department is the working day. The process of collecting data is done by taking all population data in SAP ERP module Management Software. The initial data collection for lead time was conducted in the period 2016 to 2020. The process of collecting data used a purposive sampling method with the following criteria:
- Lead time data of Regular PR
- Lead time data of PO that is connected to RFx (Request for Quotation or Tender Process)

After data collection, the data with the following information are obtained:

| Year | Total Purchased Item |
|------|----------------------|
| 2016 | 4.627                |
| 2017 | 8.132                |
| 2018 | 8.850                |
| 2019 | 5.160                |
| 2020 | 928                  |
| Total| 27,697               |

4.2. Problems Identification
The initial identification process begins with identifying the main potential problems of the length of time the procurement process. Early identification uses Ishikawa's Fishbone Analysis method to find out the potential and more detailed analysis that causes the problem. Ishikawa's Fishbone conducted by discussion of expert in Procurement Department. The appearance of Fishbone can be seen in the following image:

![Ishikawa's Fishbone of lead time](image)

As for the improvement process, it focuses on improving the policy aspect, where there are several regulations that can be reviewed so that good regulations are obtained so that the procurement process can run effectively and efficiently. Choosing policy because it has the most root problems than the others. There are four root problems of policy which are procurement method, negotiation methods, authority and maximum quotation.

The next stage in the problem identification process is to use Fault Tree Analysis so that any policies that can be improved so that the procurement process runs concisely. Fault Tree Analysis result based on benchmarking with other companies and expert judgement. The appearance of Fault Tree Analysis can be seen in the following image:
4.3. Policy Review

Procurement activity is very closely related to government regulations. The main objective of procurement is to achieve an effective, efficient and prudent in every process. Basically, the procurement process at company is governed by Decree of the Board of Directors. Those policy regulates the procurement process starting from the initial planning to the end of the procurement process which includes procedures, rules, authority, sanctions, etc. Changes the process to be more effective, efficient and prudent will needed to change the policy for entire procurement process, so that some of the root causes found previously will be adjusted to the policy.

4.3.1. Changes in the Structure of Procurement Methods. As for the 2019, the company only have 4 procurement methods consists of 4 methods namely open tender, limited tender, direct appointment dan direct purchase. In the 2020, design the procurement methods by discussion with the expert, users and also benchmarking with other companies resulting 5 methods including open tender, limited tender, quick tender, direct appointment dan direct purchase. The method comparison before and after can be seen in the following image:

Based on the data obtained, it was identified that the total purchases using Limited Tender Method have a percentage above 70%. This certainly causes the procurement lead time to be longer because the method is one of the longest and most complex methods after the Open Tender Method. Therefore, a change of method was made by adding a Quick Tender Method to reduce the percentage of Direct Selected Method. The figure of improvement of procurement method patterns:
The arrangement of the procurement method is obtained from the purchase plan data for 2020. From the data it is obtained that there are a number of items that can generally be carried out a quick auction process because of the more stringent specifications and only includes 1 maker so that no alternative alternatives are needed. From the data also obtained there are many items that can be made a direct appointment.

After data collection about average time for each method, the data with the following information are obtained:

Table 3. Data of lead time based on procurement methods

| Procurement Methods    | 2016 | 2017 | 2018 | 2019 | 2020 (estimated) |
|------------------------|------|------|------|------|------------------|
| Open Tender            | 199  | 230  | 100  |      |                  |
| Limited Tender         | 166  | 170  | 161  | 140  | 83               |
| Quick Tender           | 61   |      |      |      |                  |
| Direct Appointment     | 42   | 44   | 47   | 57   | 40               |
| Direct Purchase        | 14   | 14   | 14   | 7    |                  |

4.3.1.1. Open Tender. Tender mean buying conducted by a party by inviting vendors to present the prices and quality needed and for open tender is done openly and can be followed by anyone. In general, open tender is announce and posted on the company's website or other media. Open tender usually done for complex work and with a large of value. The appearance of open tender stages can be seen in the following image:

Figure 5. Improvement of procurement method patterns

Figure 6. Open tender stages
4.3.1.2. **Limited Tender.** Limited Tender mean buying conducted by a party by inviting vendors to present the prices and quality needed. Vendor that invited need to be registered as partner in the company. Limited tender has several stages and it will be causing lead time to be quite long.

Discussion with the expert, users and also benchmarking with other companies resulting in two branches of the limited tender method. Those are limited tender and quick tender. The difference lies in the existence of technical evaluation by user/requester or not. If the goods/services are well standardized and the specifications are clear then there is no need for a technical evaluation by the user/requester and it can be directly evaluated for business and subsequent processes the difference can be seen in the following image:

![Figure 7. Comparison limited tender stages](image)

4.3.1.3. **Direct Appointment.** Direct appointment is one of the procurement methods where the procurement department can directly point to a particular vendor. The rules regarding direct appointment are regulated in government regulations so that cannot be done carelessly. The appearance of direct appointment stages can be seen in the following image:

![Figure 8. Direct appointment stages](image)
4.3.1.4. Direct Purchase. Direct purchase is done directly without using PR and through the procurement department. User/requester can buy goods directly in the market or e-market place. The appearance of direct purchase stages can be seen in the following image:

![Diagram of direct purchase stages](image)

**Figure 9.** Direct purchase stages

4.3.2. Addition of E-Reverse Auction Method. In the previous, the company held negotiation using single negotiation system which is done in 3 ways, among others:

- Negotiation via letter or email
- Negotiations via direct communication
- Direct negotiations

Based on the data obtained that the negotiation is one of the biggest contributors to the lead time of the procurement phase. Where this process accounts for 10% of the total lead time but in the fact, negotiation consume much more time. In the data obtained that average days of negotiation around 10 days. Therefore, the addition of the negotiation process that is E-Reverse Auction that uses special software in its implementation can reduce the time of negotiations which initially took 3 days to 1 day.

E-Reverse Auction is a negotiation method using software which can be done online. Negotiations are carried out to several vendors in less than 2 hours in the allotted time. The method used is like an auction but to get the lowest price from the bid. The comparison between limited auction (single vendor) and E-Reverse Auction can be seen in the following image:

| Limited Tender | Standard Time (Working Days) | Limited Tender (E-Reverse Auction) | Standard Time (Working Days) |
|----------------|------------------------------|-----------------------------------|------------------------------|
| Start          | 0 - 1                        | Start                             | 0 - 1                        |
| PR             | 5 - 10                       | Tender Process                    | 5 - 10                       |
| Tender Process | 5 - 10                       | Technical Evaluation              | 5 - 10                       |
| Technical Evaluation | 1 - 4 | Business Evaluation | 1 - 4 |
| Business Evaluation | 1 - 5 | Tender Result | 1 - 5 |
| Tender Result | 1 - 10                       | Negotiation (E-Reverse Auction)   | 1 - 3                        |
| Negotiation   | 1 - 5                        | Contract                          | 1 - 5                        |
| Contract      | 1 - 5                        | Finish                            |                              |
| **Total Working Days** | **14 - 45** | **Total Working Days** | **14 - 38** |

**Figure 10.** Comparison between limited auction (single) and e-reverse auction
4.3.3. Authority of Signing Contract. The procurement process requires a tiered approval before being announced to bidders. In the process of making a tender, there is often a repeated approval process for each stage of procurement.

4.3.3.1. Authority Based on Procurement Objects Categories. In principle, the stages of the procurement process are inherent to the value of the procurement. Authority is only based on the value of the procurement without taking into account the object of the procurement. This certainly causes the same treatment that is received for routine and non-routine procurement. This causes problems because routine procurement which is generally in the form of raw materials, spare parts and others can be delayed and cause further problems such as decreased production, maintenance schedules are delayed etc. Based on expert judgement and benchmarking to other companies, the separation of authority is carried out into 3 categories as shown below:

**Figure 11. Comparison of authority**

4.3.3.2. Authority Based on Amount Category. The procurement stage process is also attached to the budget value of the procurement object. The greater the value, the stages of approval from the authorization level will be tiered. This certainly causes the approval process to be relatively long. Therefore, a review of the authority value limit is carried out with the following information:

**Table 4. Authority before implementation**

| Authorization Limits | Before | After |
|---------------------|--------|-------|
|                      | Based on amount | Based on category and amount |
| USD 250.001 – USD 10.000.000 | - | V Director of Strategic Services |
| USD 100.001 – USD 1.000.000 | V Director in charge, Applicant Director, Director Finance | - |
| USD 5.000.001 – USD 10.000.000 | Director in charge, Applicant Director, Director Finance | - |
| N > USD 10.000.000 | Directors’ Meeting | - |

**Determination of Procurement Method (Direct Appointment)**

| Authorization Limits | Before | After |
|---------------------|--------|-------|
|                      | Based on amount | Based on category and amount |
| USD 250.001 – USD 10.000.000 | V Director of Strategic Services | V Director in charge, Applicant Director, Director Finance |
| USD 50.001 – 250.000 | - | - | V | Director in charge, Applicant Director, Director Finance | - | - |
|----------------------|---|---|---|-------------------------------------------------|---|---|
| USD 20.001 – USD 50,000 | - | - | - | Director in charge | - | - |
| < USD 20,000 | - | - | - | V | - | - |

**Auction Result and Negotiation**

| N > USD 10,000,000 | Directors’ Meeting | - | - |
|---------------------|---------------------|---|---|
| USD 5,000,001 – USD 10,000,000 | - | - | Directors’ Meeting | - | - |
| USD 1,000,001 – USD 5,000,000 | - | - | V | Director in charge, Applicant Director, Director Finance | - | - |
| USD 100,001 – USD 1,000,000 | - | - | - | Director in charge | - | - |
| USD 20,001 – USD 100,000 | - | - | - | V | - | - |
| < USD 20,000 | - | - | - | V | - | - |

**Signing Contract**

| N > 10,000,000 | V | - | - | - | - | - |
|-----------------|---|---|---|---|---|---|
| USD 1,000,001 – USD 10,000,000 | - | - | V | - | - | - |
| USD 100,001 – USD 1,000,000 | - | - | - | Director in charge | - | - |
| USD 20,001 – USD 100,000 | - | - | - | V | - | - |
| < USD 20,000 | - | - | - | V | - | - |

**Table 5. Authority after implementation**

| Authority of Procurement (Purchasing Method and Negotiation) - Investment Goods / Services |
|---|
| No | Budget Value (USD) | Authorized Official | Remarks |
|---|-----------------|-----------------|--------|
| 1 | NA > 10,000,000 | President Director | Directors’ Meeting |
| 2 | 1,000,000 < NA <= 10,000,000 | Managing Director | Operating Directors’ Meeting |
| 3 | 100,000 < NA <= 1,000,000 | Director in charge | |
| 4 | 25,000 < NA <= 100,000 | DGM / GM | |
| 5 | NA <= 25,000 | Manager | |

| Authority of Procurement (Purchasing Method and Negotiation) - Production Goods / Services |
|---|
| No | Budget Value (USD) | Authorized Official | Remarks |
|---|-----------------|-----------------|--------|
| 1 | NA > 2,500,000 | Applicant Director | Operating Directors’ Meeting |
| 2 | 500,000 < NA <= 2,500,000 | SEVP Umum dan HC | |
| 3 | 25,000 < NA <= 500,000 | DGM / GM | |
| 4 | NA <= 25,000 | Manager | |

| Authority of Procurement (Purchasing Method and Negotiation) - Non-Production Goods / Services |
|---|
| No | Budget Value (USD) | Authorized Official | Remarks |
|---|-----------------|-----------------|--------|
By making this change, the process which was relatively long initially became more concise because generally 75% of procurement had a budget of < 25,000 USD so that with the reduced shortest approval level it was expected that the procurement process would be faster.

5. Minimum Conditions for Opening the Tender
Initially the minimum requirement for bid opening is minimum 3 quotation, this causes the procurement process to tend to be longer because the procurement must be extended. This is certainly one of the factors increasing the procurement lead time. Therefore, a change is made to the minimum bid requirement from 3 to 2 quotation. After extend tender and the result still only 1 quotation then it can be open.

6. Results
After the implementation in 2020, the lead time process in Inalum is reduce from 2016-2018 as comparison table below.

Table 6. Data results before and after application of SKDIR 2019

| CATEGORY | Year | Quartal | Lead Time Average (Days) | CATEGORY | Year | Quartal | Lead Time Average (Days) |
|----------|------|---------|--------------------------|----------|------|---------|--------------------------|
| GOODS    | 2016 | QI      | 107.42                   | QI       | 2016 | 2016 Total | 113.36                   |
|          |      | QII     | 104.02                   | QII      |      |          |                          |
|          |      | QIII    | 122.39                   | QIII     |      |          |                          |
|          |      | QIV     | 116.37                   | QIV      |      |          |                          |
|          | 2016 | Total   | 113.36                   |          |      | 2016 Total | 82.24                   |
|          | 2017 | QI      | 106.05                   | QI       | 2017 | QI       | 78.03                    |
|          |      | QII     | 96.60                    | QII      |      |          |                          |
|          |      | QIII    | 69.67                    | QIII     |      |          |                          |
|          |      | QIV     | 70.76                    | QIV      |      |          |                          |
|          | 2017 | Total   | 83.88                    |          |      | 2017 Total | 101.17                  |
| SERVICES | 2018 | QI      | 65.87                    | QI       | 2018 | QI       | 84.88                    |
|          |      | QII     | 79.51                    | QII      |      |          |                          |
|          |      | QIII    | 107.79                   | QIII     |      |          |                          |
|          |      | QIV     | 153.94                   | QIV      |      |          |                          |
|          | 2018 | Total   | 101.57                   |          |      | 2018 Total | 105.90                  |
|          | 2019 | QI      | 139.41                   | QI       | 2019 | QI       | 97.20                    |
|          |      | QII     | 135.08                   | QII      |      |          |                          |
|          |      | QIII    | 94.69                    | QIII     |      |          |                          |
|          |      | QIV     | 73.27                    | QIV      |      |          |                          |
|          | 2019 | Total   | 105.90                   |          |      | 2019 Total | 88.54                   |
|          | 2020 | QI      | 66.67                    | QI       | 2020 | QI       | 54.33                    |
|          |      | QII     | 45.44                    | QII      |      |          |                          |
|          |      | 2020 Total | 61.90                  |          |      | 2020 Total | 52.62                   |
| GOODS TOTAL | 97.59   | SERVICES TOTAL | 93.30                  |          |      | 2020 Total | 52.62                   |
From the data we can see that the implementation of improvements provides a reduction in lead time which tends to be significant. Although currently the procurement lead time of goods has not met the 45 day lead time standard but it is expected that in the future with the application of better methods and the lead time standard can achieve.

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