A CALCULATION OF COST OF QUALITY WITH ACTIVITY BASED COSTING METHOD TO MAINTAIN QUALITY BETWEEN PRODUCTION PROCESSES

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ABSTRACT

Quality is an image of a company. PT Berkat Manunggal Jaya is a company that its primary activity is to assemble the generator units. This company wants to improve its quality in its production processes. The Initial stage is to determine the amount of quality cost since that it hasn't been measured yet, especially in the production processes. This is because there are several cost categories that are within the company but the company still has not been able to measure them, which include the cost of diesel fuel for repeated inspection and the amount of diesel fuel that was carried when generators are delivered to the customers. The measuring method of this quality cost is using the Cost of Quality (COQ) model which details of the cost categories are based on Activity Based Costing (ABC) method. This method is suitable because it uses direct costs' account, for instance, the use of materials as well as indirect costs as corporate overhead costs. The detail work instructions for the inspection of the production process between departments are provided based on existing procedures in the company. This is done to reduce the unacceptable product-in-progress when the production process is in operation. After calculating and put in all the activities into the four categories of Cost of Quality, the total Cost of Quality compared with the prices of sold unit from every generator set type are 1.77% for 680 KVA type open, 1.74% for 1300 KVA first type silent, 1.74% for 1300 KVA second type silent, 2.86% for 680 KVA type silent, 1.28% for 1300 KVA first type open, 1.27% for 1300 KVA second type open, 1.13% for 1740 KVA first type open, 1.13% for 1740 KVA second type open. The recommended solution for the reduction of Cost of Quality is to modify the procedure inspection flow in the company to reduce failure cost, especially in the final inspection costs (repeated test load processes).

Key Words*: Cost of Quality (COQ); Activity Based Costing (ABC); Cost of Quality Report*

1. Introduction

If only after receiving an order from customers the company started to produce products, then this company is categorized as a make-to-order company (Gasperz, 2002a:8). The company named PT Berkat Manunggal Jaya as the case study is a generator set assembling company that belongs to this category. The main production process is to assembly radiators, engines, and generators.

Based on the interview there are internal failures that usually happen mainly because of reworks and repeated test load processes, when the result is below the standard, then causing less optimal fuel consumption. Besides that, there is also a fuel that can't be completely drained from the fuel tank, especially for the generator sets silent type. In this company the prevention activities haven't been converted to cost whereas this activity is included in the cost of a quality category (Gaperz, 2002b:169). This cost can increase the production cost, so the company should understand the details of every activity to maintain product quality in balance with the cost.

When conducting observation especially to silent type generators, the company hasn't recorded the fuel usage, for example when the unit is experiencing overheating during the load test process. Another loss is when the fuel can't be drained completely from the tank, as it can be seen in picture 1 below, about the amount of fuel that still inside the fuel tank when the generator sets delivered.

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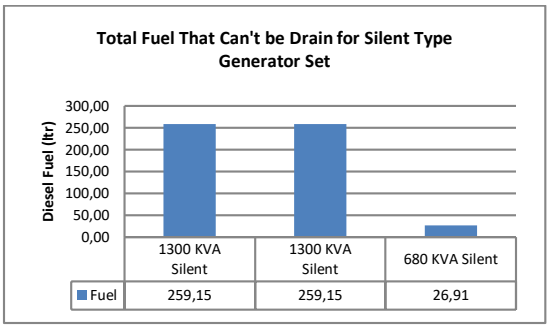
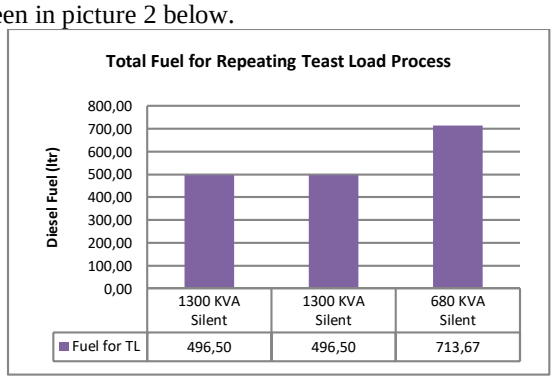


Picture 1. The Fuel Loss for Generator Sets Silent Type from January until Agustus 2014 Graph

Besides that, there are other losses caused by increasing consumption fuel because of reinspection testing in the test load process. The using of fuel for generator sets from January until August 2014 can be seen in picture 2 below.



Picture 2. The Fuel Usage for Repeated Test Load Process from January until Agustus 2014 Graph

From this increasing consumption of fuel will affect the total of cost of quality, when detailing the category in the cost of quality, there will be known the caused of the loss in the production process, the company will know the total of cost of quality.

After that company can optimize the cost for every activity in the working procedure, so the productivity will increase based on the Deming chain method about to maintain quality in production, because the final result that the company wants, based on Kaizen method is a continuous improvement (Gaspersz, 2002b:157).

Literature Study

A. Definition of Quality

There is three definitions of quality:

1. Definition of quality from Assauri Sofjan is factors from things that can make things become the purpose of people (Assauri, 1993:121).
2. Definition of quality from Vincent Gaspersz is a specialty from the product which is direct or indirect that can satisfy the user of the product and free from defect (Gaspersz, 2002b:5).
3. Definition of quality from A.V. Feigenbaum is a combining characteristics of products or services from marketing, making, and maintaining to full fill the purpose of the customer (Feigenbaum, 1992:7).

B. Category of Cost of Quality

Cost of quality can be categorized into four different categories, there are:

1. Internal Failure Costs is occurring prior to delivery or shipment of the product, or the furnishing of service, to the customer. For examples are the cost of:
   - Scrap
   - Rework
   - Failure Analysis
   - Reinspection and Testing
   - Downgrading
   - Avoidable Process Losses
2. External failure costs are occurring after delivery or shipment of the product and during or after furnishing of service to the customer. Examples are the costs of:
   - Warranty
   - Complaint Adjustment
   - Returned Product
   - Allowances
3. Appraisal costs are the costs associated with measuring, evaluating or auditing products or services to assure conformance to quality standards and performance requirements. For examples are the cost of:
   - Inspection and Testing for Incoming Materials
   - Inspection and Testing for Product in Process
   - Inspection and Testing for Final Product
   - Product Quality Audit
   - Maintenance of the accuracy of the testing equipment
   - Evaluation Stock
4. Prevention costs are the costs of all activities specifically designed to prevent poor quality in products or services. For examples are the cost of:
   - Quality Planning
   - New-product review
   - Process Control
   - Quality Audit
   - Vendor Quality Evaluation
   - Training (Gaspersz, 2002b:169).

C. Cost of Quality Measurement Model

Various methods for calculating the cost of quality are:

1. P-A-F

P-A-F conventional model was published by Juran (1951) dan Feigenbaum (1956) to classify the cost of quality into prevention, appraisal, and failure cost. The

basic suppositions of the P-A-F model are that investment in prevention and appraisal activities will reduce failure costs and that further investment in prevention activities will reduce appraisal costs.

2. Crosby

Crosby sees quality as "conformance to requirements" and therefore, defines the CoQ as the sum of the price of conformance (PoC) and price of non- conformance (PoNC). The price of conformance is the cost involved in making certain that things are done right the first time, which includes actual prevention and appraisal costs, and the price of non-conformance is the money wasted when work fails to conform to customer requirements.

3. Opportunity or Intangible

The role of intangible cost within the overall quality cost scheme. In general, intangible costs are costs that can be only estimated such as profits not earned because of lost customers and reduction in revenue owing to non-conformance.

4. Process Cost Method

The process cost is the total of the cost of conformance (CoC) and the cost of nonconformance (CoNC) for a particular process. The CoC is the actual process cost of providing products or services to the required standards, first time and every time, by a given specified process. The CoNC is the failure cost associated with a process not being operated to the required standard [7]. According to this definition, we know that the content of this categorization (CoC and CoNC) is different from that of Crosby's (PoC and PoNC) mentioned previously.

The use of a process cost model is suggested as a preferred method for quality costing within TQM as it recognizes the importance of process cost measurement and ownership and presents a more integrated approach to quality than a P-A-F model.

5. Activity Based Costing (ABC)

These deficiencies could be overcome under activity-based costing (ABC) developed by Cooper and Kaplan of Harvard Business School. ABC uses the two-stage procedure to achieve the accurate costs of various cost objects (such as departments, products, customers, and channels), tracing resource costs (including overhead costs) to activities, and then tracing the costs of activities to cost objects. ABC uses the two-stage procedure to achieve the accurate costs of various cost objects (such as departments, products, customers, and channels), tracing resource costs (including overhead costs) to activities, and then tracing the costs of activities to cost objects. (Vaxevanidis, 2008).

2. Materials and Methods

a. Preliminary Studies

Preliminary studies are an observation, interviewing and literature studying process that has been doing to known the condition of the object.

b. Literature Studies

At this stage, the study of the literature that is considered relevant to the research. Various sources are used, among others, regarding the calculation of Cost of Quality by Activity Based Costing sourced from books and research journals.

c. Production Floor Observe

At this stage, the process of observation and interviews with relevant person to obtain information as possible about the processes and activities in company included into four main categories of the COQ, so that the process of identification when processing the data to calculating the cost of quality based on the literature study of cost of Quality and by using Activity Based Costing method.

d. Problem Identification

Based on the background of the loss amount of fuel that can not be measured due to the repetition test load and the amount of fuel that can't be drawn when the product is delivered to the customer. Formulation of the problem to be studied in this research is the calculation of the cost of a loss in the event of failure of quality using calculation of Cost of Quality by Activity Based Costing, so the results of this study can be used as a recommendation for PT Thanks Manunggal Jaya to be implemented at the Department of Technical Support. Besides, with the emergence of some product rework that occurs in the sequence between the production process, companies need to improve the way the product quality inspection, so that the necessary flow of work procedures between inspection departments on every process of production.

e. Research Objectives

Based on the problems that have been formulated, the objectives of this research are:

1. To measure the loss when production unit 680 KVA type, 1300 KVA type, dan 1740 KVA type generator set.
2. To get the calculating of cost of quality for 680 KVA type, 1300 KVA type, dan 1740 KVA type generator set based on four category of cost of quality.
3. To make the work inspection procedure of inspection between the department in the production process.

f. Determine Limitations and Assumption Problems

Limitations and assumptions used in generator sets are open and silent types which have a big size

engine for 680 KVA type, 1300 KVA type, and 1740 KVA type.

g. Data Collection

a. Prevention Cost

- Quality Vendor Evaluation
  For example, the salary for purchasing department staff and quality assurance department staff.
- Quality Planning
  For example is salary for head division and department head who doing quality planning.
- Maintenance
  - Preventive Maintenance
    This is a measuring and material cost for scheduled maintenance from January until August 2014 and salary for maintenance staff who doing schedule maintenance
  - Corrective Maintenance
    This is a measuring and material cost for unscheduled maintenance from January until August 2014, and salary maintenance department staff who doing unscheduled maintenance.

b. Appraisal Cost

- Inspection and Testing for Incoming Materials
  For example, is the price for inspection equipment and salary for quality assurance department staff.
- Inspection and Testing for Product in Process
  For example, is the cost for quality control taff when doing inspection activities before delivery the finish good product.
- Inspection and Testing for Final Product For example:
  - Salary for quality control staff.
  - Cost when doing test load process.
  - Salary for test load staff.
- Maintenance of the accuracy of the testing equipment
  For example, is the cost for the calibration of inspection equipment in the company.

c. Failure of Internal Cost

- Scrap
  For example, is the waste from material that can't be used again in the production process.
- Rework
  For example are the salary for department staff that doing the rework, material cost, and operational cost for the rework process

The process of data collection is identifying the whole process that occurs within the company according to the four categories of Cost of Quality because all activities associated with the Cost of Quality if it raises the cost will affect the value of the calculation. Identification of process activities Cost of Quality in companies that have the potential of generating costs, there are:

- Failure Analysis
  For example, is the salary for technical support department staff and engineering department staff.
- Reinspection and Testing
  For example, is the salary for quality assurance staff and total fuel for repeating the test load process.
- Avoidable process losses
  For example a calculation for fuel that can't be drawn from the fuel tank after finish final inspection.

d. Failure of External Cost

- Warranty
  For example, is value after a unit has been sold.

e. Inspection Procedure
Inspection Procedure is a usual inspection that the company has been doing until now, this inspection is done by the quality assurance department.

h. Data Processing

At this stage of the processing of the data collected from the previous stage, the data will be processed with the calculation of Cost of Quality and using Activity Based Costing method, the four categories of costs in the Cost of Quality will be described with a detailed cost according to activity because such costs arise. Then the data will be processed shaped like a report calculating the cost of quality companies. While the details of the procedure for the preparation of quality inspection is done by lowering the existing procedures become more detailed and elaborate, in the form of inspection workflow procedures.

i. Analysis and Recommendation

At this stage contains the analysis of the data processing, that has been analyzed to be evaluated and determined in the calculation process which gave rise to the category of the largest costs of reporting Cost of Quality that, in addition to prevent failures in the production process will be made details of the flow of work procedures inspection so that the recommendations are made regarding the calculation of the cost of quality for the company so that can be seen in the activity which causes increasing of the quality costs and details of the workflow procedures for quality inspection should be carried out during the production process.

3. Results and Discussion

a. Calculating Cost of Quality

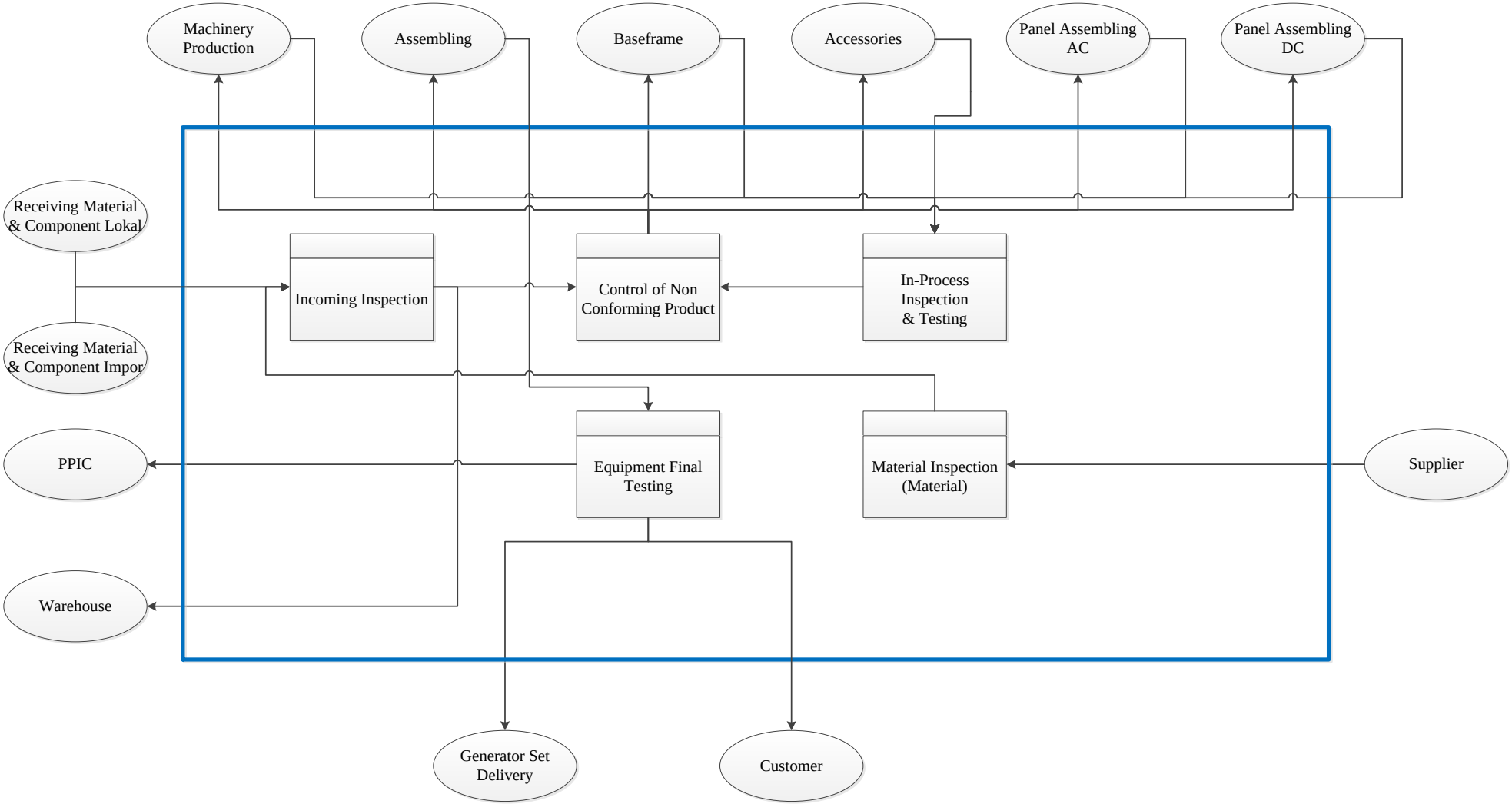
Cost of quality is combining four categories, for example calculating the cost of quality one type of generator sets that have been produced can be seen in table 1 below.

b. Detailed Inspection Procedures

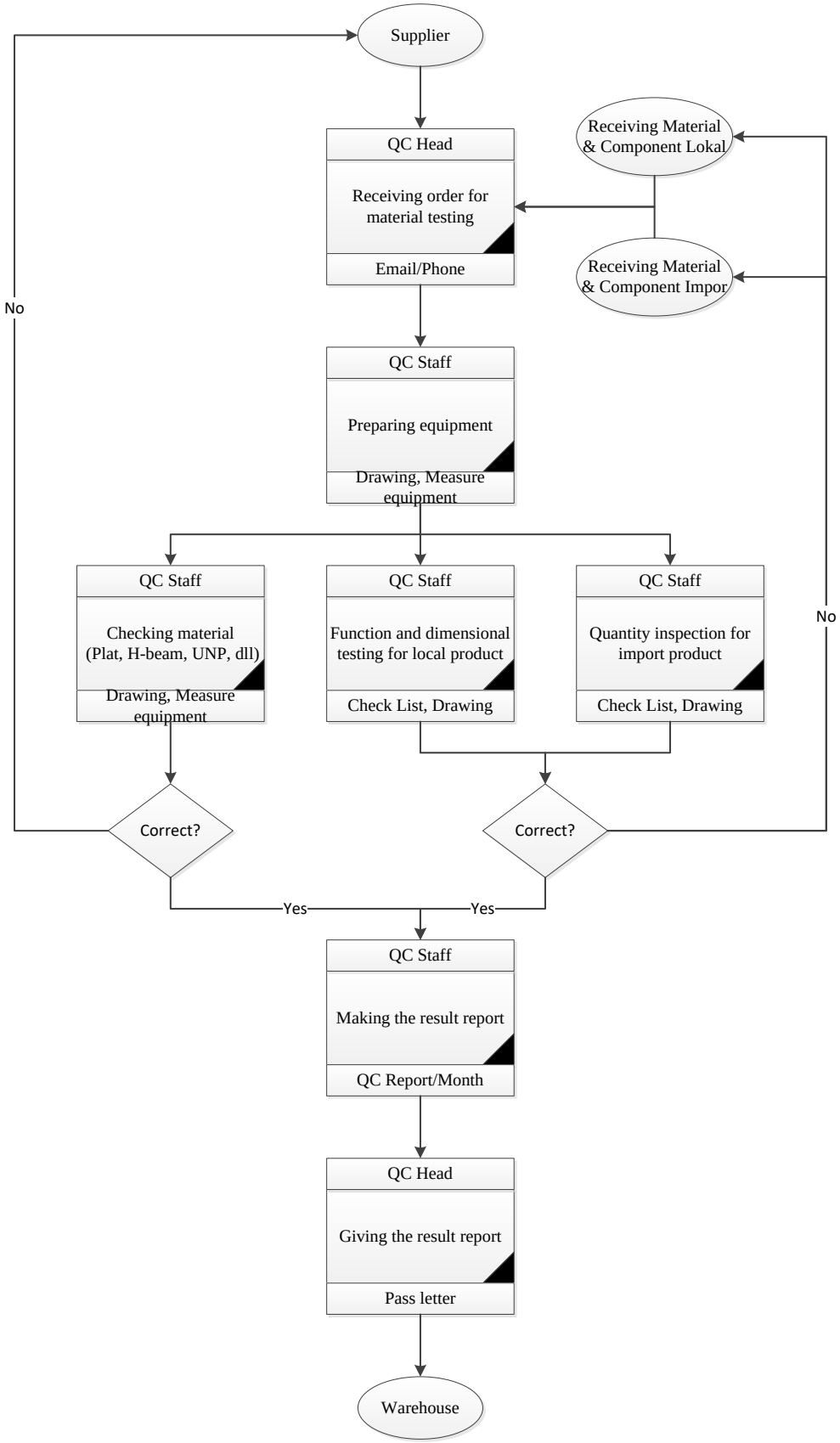
Detailed inspection procedures are made to minimize failure. This modification procedure is based on the company doing in inspection, the modification procedure can be seen below in picture 3 until picture 6.

Table 1. Total Cost of Quality for 680 KVA Type Silent

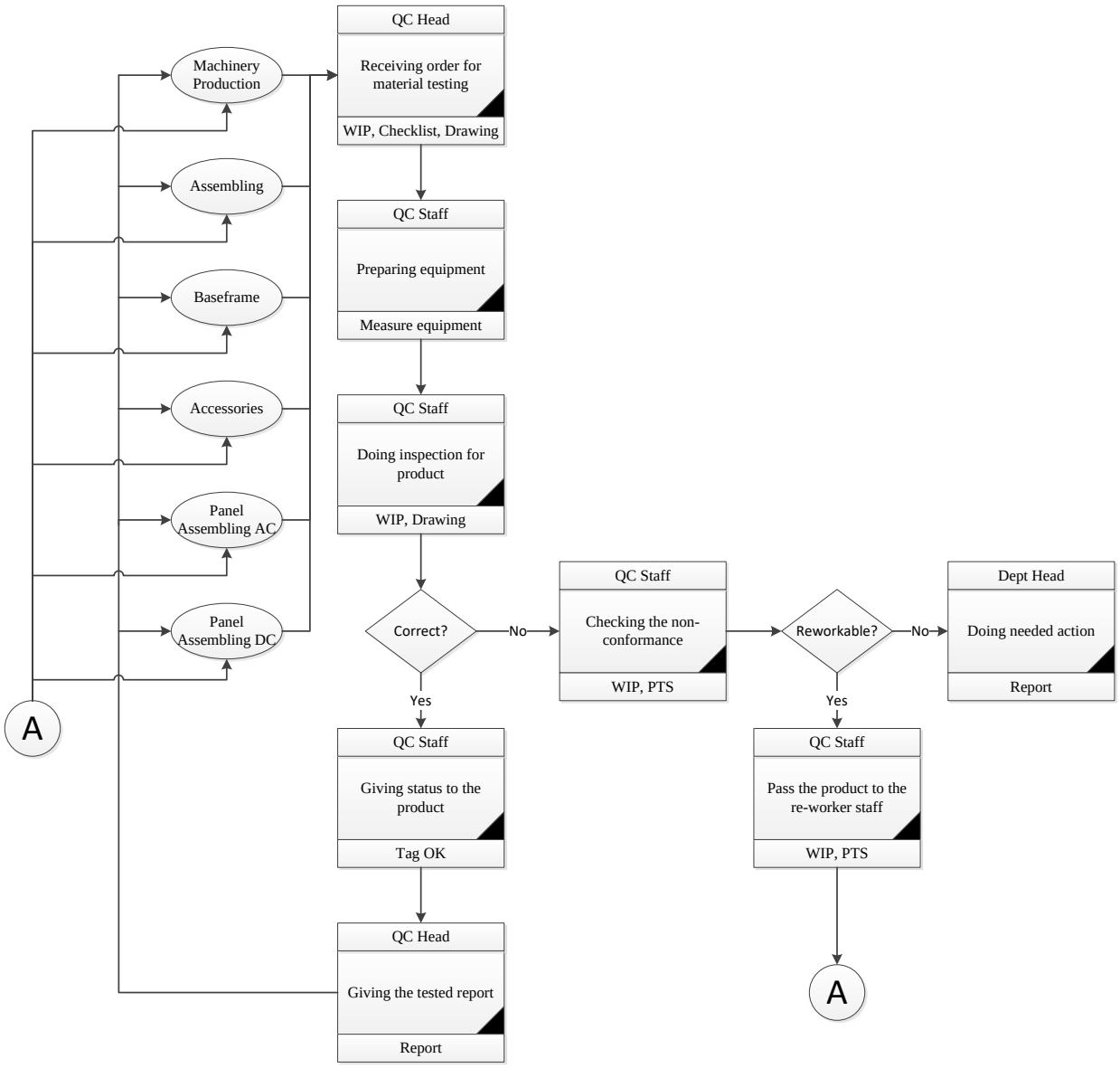
No	Cost	Product 680 KVA Silent
	Prevention Cost (in rupiahs)	
1	Vendor Choosen	89.286
2	Vendor Quality Material Evaluation	142.857
3	Quality Planning	1.726.190
4	Preventive Maintenance Planning	985.969
5	Preventive Maintenance Action	3.253.699
6	Preventive Maintenance Materials Using	1.738.433
7	Corrective Maintenance Action	394.388
8	Corrective Maintenance Materials Using	314.074
	Appraisal Cost (in rupiahs)	
1	Inspection and Testing for Incoming Materials	142.857
2	Inspection and Testing for Product in Process	125.000
3	Inspection and Testing for Final Product	133.929
4	Total Diesel Fuel for Inspection and Testing Final Product	2.585.183
	Failure Internal Cost (in rupiahs)	
1	Scrap Plate	2.964.583
2	Rework (Direct Work Hour)	714.286
3	Rework (Direct Using Materials)	7.988
4	Rework (Direct Using Electric)	42.954
5	Failure Analysis	2.502.976
6	Reinspection and Testing (Direct Work Hour)	120.536
7	Reinspection and Testing (Direct Using Materials)	8.528.317
8	Avoidable Process Losses	321.585
	Failure External Cost (in rupiahs)	
1	Warranty	5.340.000
Total Cost of Quality for 680 KVA Silent Type Generator Set (Rp)		**32.175.089**



Picture 3. Modification Inspection Procedure



Picture 4. Modification Inspection Procedure for Incoming Material



Picture 5. Modification Inspection Procedure for Product in Process

4. Conclusions

The conclusions from the result after doing research are:

a. The loss for every produced unit in the company from January until August 2014, with counting failure internal and external cost for every product that has value percentage higher than 50 % which is needed to be maintained for reducing failure cost, there is the cost of failure percentage for every product:

1) For type 680 KVA open the internal failure cost is Rp 1.666.002,26 and the external failure cost is Rp 4.590.000,00. The combination failure internal and external cost percentage is 38,26%.

2) For the first type 1300 KVA silent the internal failure cost is Rp 13.863.368,63 and the external failure cost Rp 11.400.000,00. The combination failure internal and external cost percentage is 60,42%.

3) For the second type 1300 KVA silent the internal failure cost is Rp 13.863.368,63 and the external failure cost is Rp 11.400.000,00. The combination failure internal and external cost percentage is 60,42%.

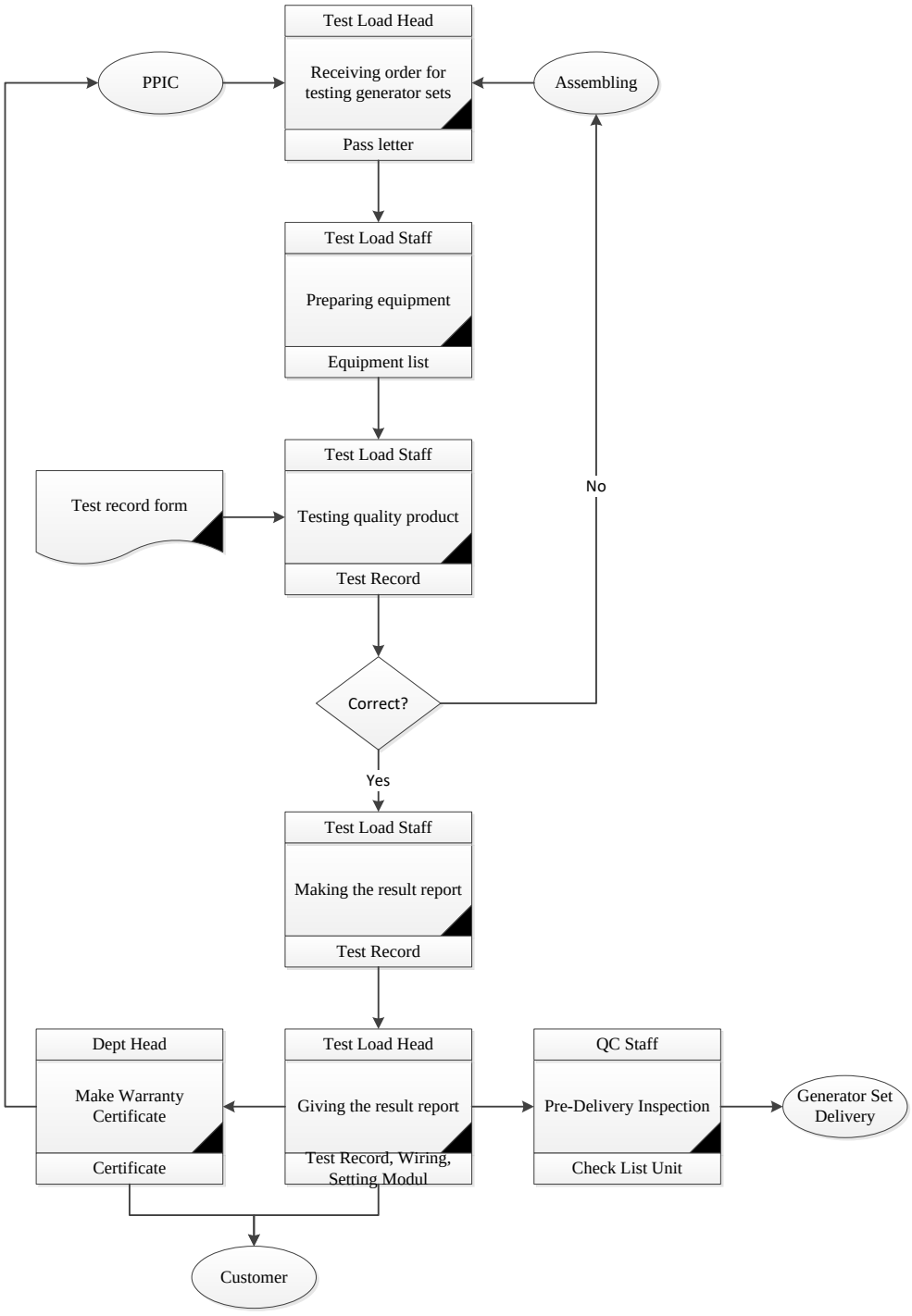
4) For type 680 KVA silent the internal failure cost is Rp 15.203.223,93 and the external failure cost is Rp 5.340.000,00. The combination failure internal and external cost percentage is 63,85%.

5) For the first type 1300 KVA open the internal failure cost is Rp 2.471.316,53 and the external failure cost Rp 10.161.000,00. The combination failure internal and external cost percentage is 46,54%.

6) For the second type 1300 KVA open the internal failure cost is Rp 2.471.316,53 and the external failure cost is Rp 10.161.000,00. The combination failure internal and external cost percentage is 44,87%.

7) For the first type 1740 KVA open the internal failure cost is Rp 2.251.562,48, and the external failure cost is Rp 12.786.780,00. The combination failure internal and external cost percentage is 50,21%.

8) For the second type 1740 KVA opens the internal failure cost id Rp 2.251.562,48, and the external failure cost is Rp 12.786.780,00. The combination failure internal and external cost percentage is 50,36%.



Picture 6. Modification Inspection Procedure for Final Product

b. Cost of quality is a combination from 4 categories, there is internal failure cost, external failure cost, prevention cost and appraisal cost, the measure of the cost of quality for every unit are:
   1) For type 680 KVA open the cost of quality is Rp 16,349,995,12. The percentage comparison between the cost of quality and the value of sales is 1,78%.
   2) For the first type 1300 KVA silent the cost of quality is Rp 41,812,934.10. The percentage comparison between the cost of quality and the value of sales is 1,83%.
   3) For second type 1300 KVA silent the cost of quality is Rp 41,812,934.10. The percentage comparison between the cost of quality and the value of sales is 1,83%.
   4) For type 680 KVA silent the cost of quality is Rp 32,175,089.40. The percentage comparison between the cost of quality and the value of sales is 3,01%.
   5) For the first type 1300 KVA open the cost of quality is Rp 27,145,229.61. The percentage comparison between the cost of quality and the value of sales is 1,34%.
   6) For th second type 1300 KVA open the cost of quality is Rp 26,950,046,27. The percentage comparison between the cost of quality and the value of sales is 1,33%.
   7) For the first type 1740 KVA open the the cost of quality is Rp 29,950,869,84. The percentage comparation between the cost of quality and the value of sales is 1,17%.
   8) For the second type 1740 KVA open the cost of quality is Rp 29,863,236.51. The percentage comparison between the cost of quality and the value of sales is 1,17%.

c. The modification details of inspection procedures are :
   1) Inspection procedure for incoming materials
   Inspection material in the supplier process and detail about the material flow to the warehouse after the inspection process should be added to the procedure.
   2) Inspection procedure for production in process
   Second decision process about separating good work in process product and defect work in process product should be added to the procedure.
   3) Inspection procedure for the final product
   Pre Delivery Inspection process should be added to the procedure to assure the identity of the product.

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