The Evaluation of Maturity Level on Heavy Equipment Maintenance Management According to ISO 55001:2014

Nurhadi Siswantoro¹, Dwi Priyanta¹, Steven Gautama¹,², Muhammad Badrus Zaman¹, Trika Pitana¹, Hari Prastowo¹, Ratu Balqis F¹, Ardi Nugroho Yulianto³,⁴

¹Department of Marine Engineering, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia
²Department of Maritime Studies, Systems Engineering and Logistics, Hochschule Wismar, Germany
³Department of Naval Architecture, Institut Teknologi Sepuluh Nopember (ITS), Surabaya, Indonesia
⁴Department of Naval Architecture and Marine Engineering, Mokpo National University, Republic of Korea

corresponding author’s e-mail: nurhadi@ne.its.ac.id

Abstract. One of the challenges experienced by companies nowadays is keeping their value of assets which will affect the value of the companies. The companies need to provide certainty to the stakeholders from both internal and external perspectives. These things are important for companies that have a high and large value asset. PT. X is one of the shipping lines in Indonesia and with the large task of shipping companies, it has a large number and high value of assets. Heavy equipment is of the assets that have supported the company’s main business process in the loading-unloading process. By now, there has never been an asset management maturity level on PT. X. Therefore, an evaluation of measurement of the heavy equipment maintenance management system is conducted based on the guidelines of ISO 55001: 2014. The results of the assessment showed that the maturity level of heavy equipment management is 2.7 and there are 13 sub-optimal sub-clauses that need improvement by the company.

Keywords: Asset management, asset maturity level, heavy equipment, maintenance management evaluation.

1. Introduction
The management of assets enables companies not only to focus on how the assets can be used but also to obtain a certain value that can be achieved in relation to the companies’ goals. Every company has its own different steps and ways of determining and achieving this value. Asset management is a series of activities carried out to obtain values of the existing set of assets, the activities referred are the activities carried out in an asset management system [1], [2], [3]. Generally, the scope of asset management will include 6 parts, strategic planning, asset management decision-making systems, asset life cycle, asset information, human resource & organization, and risk & evaluation [4], [5], [6].

PT. X is one of the largest shipping companies for over half a decade with more than 20 branches spread all over Indonesia. As a large archipelago nation, PT. X has a great opportunity in the field of sea transportation to provide delivery services of goods. To maintain its consistency in being
the best shipping lines and delivering services of goods, PT. X is determined to foster good management in providing its delivery standards. This standard can be achieved with the management of assets and equipment which are essentials to increase productivity and operational activities. Heavy equipment is one of the assets which supports the operations of PT. X, especially in the process of loading-unloading. The equipment should always be in a good condition and ready to be used both regularly and in an emergency to ensure the working process could be done. It is essential to have a system that regulates the maintenance and repair of the equipment. PT. X owned 4 types of heavy equipment, which are trailers, rubber-tired gantry, reach stacker, and forklift. Considering the large productivity and asset value owned by PT. X and problems that occur in terms of human resources, mechanisms, and control of asset management, it is necessary to evaluate the performance of asset management for heavy equipment through asset management maturity assessment.

Previous research in the field of asset management has been carried out by many researchers and applied to the industry. Research is done by Peter Okoh et al (2016) about the new maintenance management model (AMMP) based on ISO 55000 stated that maintenance management improvisation is needed to optimize the total asset value over the entire asset’s life cycle [7]. A. Albalghouni et al (2018) conducted research on an educational institute stated that there are several steps in implementing the ISO 55001 standards. The results of the assessment will be analyzed to identify the gaps in the current assets management system and to identify the challenges in implementing the requirements of ISO 55001 [8]. Another research conducted by B. Bidgeli (2015) on the accreditation of ISO 55001 at the Airport-link Tunnelled-Motorway Services Company mentioned the process of the assessment [9]. Y. Abe and T. Mizutani (2016) evaluated asset management on the Sendai Wastewater utility, Japan. This wastewater utility has acquired the certification of ISO 55001. Several processes were done in acquiring the certification, from maturity assessment, internal audit, and certification exam [10]. Meanwhile, in the power plant sector, asset management is also applied through the performance indicator and balanced scorecard methods (Silva, 2020) [11]. The usefulness of a maturity model in an organization depends on the efforts being made to describe the entire field and business processes, determine the appropriate criteria to reach a certain maturity level, and determine the methods and techniques to achieve this [12], [13], [14], [15].

Therefore, this research focuses on the condition of the maturity level of the current heavy equipment maintenance management in PT. X based on ISO 55001: 2014. Then strategies can be done by PT. X to improve the asset management’s maturity level that is not optimal yet based on the guidelines from the ISO 55002: 2018.

2. Methods

2.1. Data Collection

The data collection used is divided into 2 categories, primary data, and secondary data. The secondary data were taken from the literature studies which also include documentation, government publications, websites, and others. The primary data were taken from the organization structure, maintenance management system, observation, and interviews from the human resources of PT. X.

Several means of techniques are used to gain the data collection. This research mainly used questionnaires by interviews, discussion, and direct observation throughout PT. X. Interviews were conducted to obtain primary data. This interview used a questionnaire based on the ISO 55001:2014 Self-assessment questionnaire. Interviews were conducted through direct question and answer with the respondents where the respondent is someone who understands the area being discussed.

The respondent in PT. X was chosen from the regulator level, decision-maker, and executive level. Which are taken from the organization’s structure of PT. X in the department of Heavy Equipment. From the following, the list of respondents can be divided into 7 levels which are Middle Manager, Junior Manager, Team Leader, Senior Staff, Staff, Worker, and Non-Grade.

2.2. Data Processing

To find the gap between the ideal state of the asset management based on ISO 55001:2014 and the current condition, several processes must be done. The gap analysis is done firstly from the
questionnaire by interview, continued by the maturity level assessment, and followed by the improvement strategies analysis.

2.3. Asset Management Maturity Level Assessment

After having the right respondent for the questionnaire, the next step is to assess each sub-clauses based on the scoring provided with the parameter of the ISO 55001:2014 maturity level [16]. Based on the available evidence, matching is made with the prerequisites listed at each level to determine the value of the maturity level of asset management in the organization. A measure of the level of maturity can be seen in table 1.

The weighting process is carried out after including evidence in all available sub-clauses, then the results will be obtained in the form of a radar chart containing the performance value of the organization's asset management. Then this radar chart is analyzed to see which sub-clauses are not yet optimal.

| Scale | Level | Description |
|-------|-------|-------------|
| 0     | Innocent | The organization is not yet aware of the need to implement the related clauses and there are no definite steps to implement them. |
| 1     | Aware | The organization understands the need for the application of the related clauses and the initiation to implement them. |
| 2     | Developing | The organization has identified a suitable system and consistently achieves the targets of the related clauses and is progressing its implementation to improve performance. |
| 3     | Competent | The organization has identified a system that is suitable and consistently achieves the targets of the related clauses listed in ISO 55001. |
| 4     | Beyond | The organization has identified a suitable system and consistently optimizes asset management performance in line with the organization's objectives and operations. |
| 5     | Beyond | The organization has achieved maximum value in asset management and has become a benchmark in the application of asset management that is aligned with the objectives and operations of the organization. |

2.4. Data Testing

The gap analysis is done when the respondent has filled the questionnaire and its assessment. These data will be tested before continuing with the analysis. These tests are the validity and the reliability of the questionnaire which would be used as the research instrument.

Step 1. Data Validation

The validity is determined by correlating the scores obtained from each item in the form of questions with a total score. This total score is the value obtained from the sum of all item scores. Based on statistical measures, if it turns out that the scores of all items arranged according to the conceptual dimensions are correlated with the total score, it can be said that the measuring instrument has validity. Validation can be measured by the equation of the Pearson’s product-moment method as follows [17]:

\[ r = \frac{N\Sigma XY - (\Sigma X \times \Sigma Y)}{\sqrt{(N\Sigma X^2 - (\Sigma X)^2) \times (N\Sigma Y^2 - (\Sigma Y)^2)}} \]
Where:
- \( r \) : Correlation index between variables \( X \) and \( Y \), the two variables are tolerated
- \( N \) : Number of samples or number of respondents
- \( X \) : The score of the subject obtained in each item
- \( Y \) : The total score obtained by the subject of all items
- \( \sum X \) : The sum of scores in an ordinal \( X \) distribution
- \( \sum Y \) : The sum of scores in the \( Y \) distribution which is ordinal
- \( \sum X^2 \) : Square factor of variable factor \( X \)
- \( \sum Y^2 \) : Square factor of variable factor \( Y \).

The decision to test the validity of the instrument is if “\( r \) calculation” is bigger than equal to “\( r \) table”, then it means valid. The “\( r \) table” can be seen in Table 2. The level of significance means the confidence level of the instruments, where 5% means it has a confidence level of 95%. This value is used in this research.

| \( N \) (df) | The Level of Significance (5%) |
|-------------|-------------------------------|
| 3           | 0.997                         |
| 4           | 0.950                         |
| 5           | 0.878                         |
| 6           | 0.811                         |
| 7           | 0.754                         |
| 8           | 0.707                         |
| 9           | 0.666                         |
| 10          | 0.632                         |
| 11          | 0.602                         |
| 12          | 0.576                         |

**Step 2. Data Reliability**

Reliability means the level of confidence and the results of a measurement. Measurements that have high reliability are measurements that can provide reliable measurement results. Reliability is one of the main characteristics or characteristics of a good measurement instrument. The main idea in the concept of reliability is the extent to which the results of a measurement can be trusted, meaning the extent to which the measurement result scores are far from measurement errors. In this research, to calculate reliability is used the formula of Spearman-Brown [18].

\[
 r_{11} = \frac{2 \times r_b}{1 + r_b}
\]  

(2)

Where:
- \( r_{11} \) : Reliability coefficient of all items product
- \( r_b \) : Moment coefficient between section of the odd-even questions

The reliability test of the split-half Spearman-Brown method, in principle, is carried out by dividing two items of per variable instrument questions between odd and even questions. Then linked to the Spearman-Brown correlation formula through a spreadsheet. If the correlation analysis is greater than 0.8 then the research instrument can be declared reliable.
3. Result and Discussion

3.1. Maturity Level Assessment on PT. X

The ISO 15001:2014 consists of several clauses which describe the organization's requirements that must be achieved. Each clause will be assessed for its maturity level. Table 3 shows the clauses of ISO 15001:2014.

| Table 3. Clauses of ISO 55001: 2014 [16] |
|------------------------------------------|
| Aspect | Clauses | Description |
|--------|---------|-------------|
| Organization Context | 4 | 4.1 | Understand the organization context |
| | | 4.2 | Understand the needs and hopes of the stakeholder |
| | | 4.3 | Identify the asset management system |
| | | 4.4 | Design the asset management system |
| Leadership | 5 | 5.1 | Leadership and commitment |
| | | 5.2 | Organization’s policy |
| | | 5.3 | Roles, organizational responsibilities, and authorities |
| Planning | 6 | 6.1 | Action to assess risks and opportunities |
| | | 6.2 | Asset management goals and planning to achieve them |
| Support | 7 | 7.1 | Sources |
| | | 7.2 | Competency |
| | | 7.3 & 7.4 | Awareness and communication |
| | | 7.5 & 7.6 | Support systems & documented information |
| Operation | 8 | 8.1 | Operational planning and control |
| | | 8.2 & 8.3 | Change management & outsourcing of asset management activities |
| Work Evaluation | 9 | 9.1 | Monitoring, controlling, analysis and evaluation |
| | | 9.2 | Internal audit |
| | | 9.3 | Management review |
| Improvement | 10 | 10.1 | Non-conformity analysis and corrective action |
| | | 10.2 | Continuous improvement |
| | | 10.3 | Preventive and predictive action |

The gap analysis is carried out between the current conditions of heavy equipment management in PT. X with the ideal condition of the asset management based on ISO 55001:2014. This gap is defined in the form of a maturity level, where the level maturity of 3 and above means the asset management has fulfilled the ISO 55001: 2014 guidance. The results with a maturity level of below 3 will be given strategies to overcome the aspects that are not optimal with the guidance of ISO 55002: 2018 [19].

The average maturity level based on ISO 55001: 2014 is obtained by the overall maturity level in each clause from each resource divided by the respondent of the research. The average is used to determine the overall maturity level of the organization’s heavy equipment maintenance management as well as an overview of the clauses that are not optimal yet and needed to be given strategies for improvement. In addition, this average shows the asset management of the organization’s gap between the ideal condition based on the ISO 55001: 2014. The overall maturity level of heavy equipment management is 2.7. Table 4 shows the detail of maturity level on each sub-clause, and the gap chart can be seen in figure 1.
Figure 1. Overall maturity level on PT. X

Table 4. Overall maturity level assessment

| Aspect            | Clauses | Description                                                                 | Maturity Level |
|-------------------|---------|------------------------------------------------------------------------------|----------------|
| Organization      | 4       | Understand the organization context                                          | 3.0            |
| Context           | 4.1     |                                                                             |                |
|                   | 4.2     | Understand the needs and hopes of the stakeholder                           | 3.0            |
|                   | 4.3     | Identify the asset management system                                         | 3.0            |
|                   | 4.4     | Design the asset management system                                           | 2.7            |
| Leadership        | 5       | Leadership and commitment                                                    | 3.0            |
|                   | 5.1     |                                                                             |                |
|                   | 5.2     | Organization’s policy                                                        | 3.0            |
|                   | 5.3     | Roles, organizational responsibilities, and authorities                      | 3.0            |
| Planning          | 6       | Action to assess risks and opportunities                                      | 3.0            |
|                   | 6.1     |                                                                             |                |
|                   | 6.2     | Asset management goals and planning to achieve them                          | 2.7            |
| Support           | 7       | Sources                                                                      | 2.5            |
|                   | 7.1     |                                                                             |                |
|                   | 7.2     | Competency                                                                   | 2.2            |
|                   | 7.3     | Awareness                                                                    | 2.7            |
|                   | 7.4     | Communication                                                                | 2.1            |
|                   | 7.5     | Support systems                                                              | 2.6            |
|                   | 7.6     | documented information                                                       | 2.3            |
| Operation         | 8       | Operational planning and control                                             | 3.0            |
|                   | 8.1     |                                                                             |                |
|                   | 8.2     | Change management                                                            | 3.0            |
|                   | 8.3     | outsourcing of asset management activities                                   | 2.5            |
| Work Evaluation   | 9       | Monitoring, controlling, analysis and evaluation                             | 2.5            |
|                   | 9.1     |                                                                             |                |
|                   | 9.2     | Internal audit                                                               | 3.0            |
|                   | 9.3     | Management review                                                            | 2.6            |
| Improvement       | 10      | Non-conformity analysis and corrective action                                 | 2.5            |
|                   | 10.1    |                                                                             |                |
|                   | 10.2    | Continuous improvement                                                       | 2.7            |
|                   | 10.3    | Preventive and predictive action                                             | 3.0            |
The chart illustrates the maturity level of the entire Heavy Equipment Management on PT. X from the perspective of a middle manager, junior manager, team leader, senior staff, staff, worker, and non-grade. It will be used as a reference in developing a strategy for improving asset management to reach a more competent maturity level.

3.2. Data Testing

The validation of the data is measured by equation 1. This research used a spreadsheet with the formula of correlation. The total score of each question from all the respondents is being summed. For example, the total score of question number 1 are being calculated by multiplying the scoring of that question with the total respondents. Then the total score of the 39 questions from each respondent is also being summed and done for all the other respondents. These two numbers will then be correlated with the spreadsheet such as follows in table 5.

The r table 0.602 is gained from table 2. Where the number of significance used is 95% with the total respondent of 11 respondents. The data are stated valid when the r calculation is bigger or equal to the r table. The r calculation is gained from the correlation as mentioned before. From 39 questions all the assessments are valid.

| Respondents | Scoring | Total |
|-------------|---------|-------|
| Number of Questions | 1 | 2 | 3 | 4 | … | 39 | 107 |
| 1 | 3 | 3 | 3 | 2 | … | 3 | 111 |
| 2 | 3 | 3 | 3 | 3 | … | 3 | 130 |
| 3 | 3 | 4 | 4 | 3 | … | 3 | 128 |
| 4 | 3 | 3 | 3 | 4 | … | 4 | 130 |
| … | … | … | … | … | … | … |
| 11 | 3 | 3 | 3 | 3 | … | 3 | 94 |
| r calculation | 0.72 | 0.65 | 0.67 | 0.67 | … | 0.81 |
| r table | 0.602 |
| Valid/ No | Valid |

Table 6. Reliability Test

| TOTAL | Odd Question | Even Question |
|-------|--------------|---------------|
| 55 | 52 |
| 57 | 54 |
| 65 | 65 |
| 66 | 62 |
| 67 | 63 |
| 45 | 45 |
| 59 | 53 |
| 32 | 32 |
| 64 | 60 |
| 57 | 55 |
| 49 | 45 |

| rb | 0.984157804 |
| Spearman-Brown | 0.992015657 |
| Summary | Reliable |

The reliability of the data should also be tested. This research tests the reliability of the assessment with the Spearman-Brown by equation 2. Where the questions are separated between odd and even questions numbers. Then the total odd-scoring is being summed and so does the even-
scoring. Then these 2 numbers are being correlated with the correlation formula in the spreadsheet and \( r_b \) is found. Then the \( r_b \) will then be input into the Spearman-Brown equation. The number found should be bigger than 0.8 to be stated as a reliable instrument. The instrument is stated to be highly reliable because it’s higher than 0.8. Table 6 shows the result of reliability test.

3.3. Strategy Analysis
The strategy analysis is done to the sub-optimal sub-clauses which have a maturity level of below 3 (competent). These strategies are done based on the guidelines of ISO 55002: 2018 which also refers to the points contained in ISO 55000: 2014 and ISO 55001: 2014. The steps to analyze the strategies are done by analyzing the difference between the levels of maturity below the standard of competent, then analyzing the improvement strategies.

3.3.1 Clause 4
The improvement strategy in clause 4 only includes the sub-clauses 4.4 regarding the asset management system, while the other sub-clauses have reached the competent level. PT. X organization maturity level regarding sub-clauses 4.4 is 2.7. This indicates that the organization needs several strategies to be optimal and reach a competent level. Table 7 show the improvement strategies of sub-clauses 4.4.

| Improvement Strategies |
|-------------------------|
| 1. PT. X must consistently achieve and develop its asset management system objectives by integrating the performance indicators of its respective assets while it is in operation. |
| 2. The HVE department must measure HVE assets periodically and develop performance indicators for each asset according to the specifications of each asset so that PT. X’s asset management objectives can be developed and achieved. |
| 3. PT. X must integrate the HVE Department with the Yard Operations and Inland Service Departments in the use of TOMS and appHVE. So that there is an integration between asset management and other functions. |

3.3.2 Clause 6
In clause 6 there are only one sub-clauses that needs to be improved to be at the competent level which is sub-clauses 6.2.1. This sub-clauses is regarding the planning to achieve the asset management objectives and is currently at the maturity level of 2.7. Table 8 shows the improvement strategies of sub-clauses 6.2.1.

| Improvement Strategies for Sub-clauses 6.2.1 |
|---------------------------------------------|
| 1. Each level of management in the HVE department must consistently implement the mechanisms in achieving asset management objectives based on existing KPIs and quality objectives. |
| 2. PT. X must consider the risk management of each of its assets in planning its asset management objectives. |
| 3. PT. X must regularly monitor the performance of each asset based on the performance indicators of each tool (HVE operator). |
| 4. Cross-division for every related management level should be held periodically. |
| 5. Training operators regarding periodic hour-matter recording must be done so that asset management objectives can be achieved. |

3.3.3 Clause 7
The improvement in clause 7 includes 6 different sub-clauses which has not reached the competent maturity level. This includes sub-clauses 7.1, 7.2, 7.3, 7.4, 7.5, and 7.6. All of these sub-clauses are on the level of developing (level 2) and need several strategies to be improved. Table 9-14 show the improvement strategies of clause 7.
Table 9. Improvement strategies for sub-clauses 7.1

| Improvement Strategies |
|------------------------|
| 1. PT. X must have a mechanism in determining the priority scale for the fulfilment of its resources with a critical table so that asset management objectives can be achieved. |
| 2. Risk analysis and mitigation on each asset must always be carried out and taken into consideration in preparing the needs of each level on PT. X. |
| 3. Compilation of spare part requirements must be in accordance with the workload analysis and capacity of each asset. |

Table 10. Improvement strategies for sub-clauses 7.2

| Improvement Strategies |
|------------------------|
| 1. Human resources in each function must have competencies that match the required criteria and have achieved the desired indicators. |
| 2. Competencies mapping by each head of the division of each level of management in the form of report cards for everyone which includes the performance of each HR performance. |
| 3. Training for each HR related to organizational level functions based on the consideration of each HR's report card in the related function. |

Table 11. Improvement strategies for sub-clauses 7.3

| Improvement Strategies |
|------------------------|
| 1. Human resources at each level of the organization management must always comply with the mechanisms and procedures that apply in the supervision and assessment carried out by the leaders of each level of the organization management. |
| 2. PT. X must take a firm stand against deviant HR by giving a warning or sanction based on the PT. X mechanism. |

Table 12. Improvement strategies for sub-clauses 7.4

| Improvement Strategies |
|------------------------|
| 1. Meetings between top management and the HVE department periodically and cross-division meetings between divisions in HVE. |
| 2. The context and criteria for the information specified must always be conveyed to the appropriate parties and functions and not deviate from unrelated parties and functions. |
| 3. KPIs and targets must be communicated periodically so that asset management objectives can be achieved. |

Table 13. Improvement strategies for sub-clauses 7.5

| Improvement Strategies |
|------------------------|
| 1. PT. X must improve THE data on the HVE web which includes asset specifications, historical failure asset data, and a logbook of each asset. |
| 2. PT. X should have the means of giving information personally to the related person per asset (Integrated real-time). |
| 3. Users associated with each HVE asset must always upload related documents which are controlled by each division head. |

Table 14. Improvement strategies for sub-clauses 7.6

| Improvement Strategies |
|------------------------|
| 1. Training of human resources in certain functions regarding mechanisms, procedures, and rules regarding asset documents. |
| 2. PT. X must document and record every failure of existing assets so that they can be developed into predictive maintenance. |
| 3. PT. X must create certain KPIs regarding recording and updating of documents for each asset |
| 4. Giving access to update the document for the user concerned. |
| 5. Creating condition monitoring or module real-time for certain assets such as hour matter for trailer use. |
| 6. PT. X must evaluate and improve the access, use, and storage of documents that have been integrated on the web based. |
3.3.4 Clause 8
The improvement strategy in clause 8 only includes the sub-clauses 8.3 regarding the outsourcing of asset management activities which has a maturity level of 2.5. While the other sub-clauses have reached the competent level. This indicates that the organization needs several strategies to be optimal and reach a competent level. Table 15 shows the improvement strategies of sub-clauses 8.3.

| Improvement Strategies |
|------------------------|
| 1. Asset management activities and processes requiring outsourcing must be well identified and their implementation or procurement facilitated by the organization. |
| 2. The results of the outsourcing are monitored, and periodic assessments are carried out to ensure that the activities carried out are in accordance with the goals desired by the organization. |

3.3.5 Clause 9
There are two sub-clauses in clause 9 that have not reached the competent maturity level. The first sub-clauses are sub-clauses 9.1 which has a maturity level of 2.5. While sub-clauses 9.3 have a maturity level of 2.6. Table 16 and table 17 show the improvement strategies of sub-clauses 9.1 and 9.3.

| Improvement Strategies |
|------------------------|
| 1. PT. X must consistently carry out personal assessments from each team leader to its staff at each management level. |
| 2. PT. X must consistently set the evaluation mechanism for asset management up to the executive level according to the achievement indicators of each level. |

3.3.6 Clause 10
In clause 10, two sub-clauses need to improve because of the maturity level which has not reached the level of competence. The first sub-clauses are 10.1 which has a maturity level of 2.5 and sub-clauses 10.2 which has a maturity level of 2.7. Table 18 and table 19 show the improvement strategies of sub-clauses 10.1 and 10.2.

| Improvement Strategies |
|------------------------|
| 1. PT. X should consistently document the failure of the assets, investigating the failure potential, and the asset failure. |
| 2. PT. X should develop a risk-based and lifecycle analysis for the assets. |

3.3.7 Strategy Implementation Framework
After all the sub-optimal sub-clauses are given improvement strategies based on the ISO 55002: 2018 which also contained points from ISO 55000: 2014 and ISO 55001: 2014, a strategic framework is formulated. The framework shows the correlation of increasing asset maturity level 2 to 3 with the benefits if the asset management improvement is implemented. To prioritize the improvement
strategy, PT.X can consider based on the lowest maturity level in each clause. In addition, the company can adjust the cost analysis needed to increase the maturity level, so that technically and economically it will provide benefits to the company. Figure 2 shows the strategy improvement framework.

4. Conclusion
Evaluation of heavy equipment maintenance management at PT. X based on ISO 55001:2014 shows that the current overall maturity level is 2.7. This indicates that the heavy equipment maintenance management on PT. X is on maturity level 2 (developing level) or has not reached the competent level. Overall, there are 11 sub-clauses with a competent maturity level and 13 sub-clauses with a developing maturity level which is sub-optimal and needs to be improved. Those 13 sub-clauses need several improvement strategies to be optimal and improve heavy equipment management. The improvement strategy is formulated by the guidelines of ISO 55002:2018. In addition, the recommended improvement strategies are given to each sub-clauses in the form of a framework and several strategies that have complied with PT. X which could be developed furthermore. To prioritize the improvement strategy, PT.X can consider based on the lowest maturity level in each clause. Furthermore, it is necessary to analyze the costs needed to increase the maturity level, so that technically and economically it will provide benefits to the company to reach maturity level 3.

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