EVALUATION OF ASSET INTEGRITY MANAGEMENT STRATEGY AND ITS IMPLEMENTATION ON PRODUCTION CRITICAL ASSET: (CASE-STUDY OF OPEN MINE COMPANY, IN SOUTH SULAWESI, INDONESIA)

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ABSTRACT

The purpose of this research is to evaluate compliance of Asset Integrity Strategy implementation at mining company for critical production assets established policy towards AMF, and recommend company management to improve asset integrity implementation that to align with company policy. As it is indicated, the asset integrity management scorecard is not established well in the company, and there is no available standard of competence for maintenance engineers, incomprehensive of asset registering system, without involving all asset establishment parties, and there is no clear delegation between the support team and maintenance engineer in the roles of asset integrity management. The analysis method is used in this research is descriptive and qualitative analysis by obtain sample population from all asset integrity management role holders. The results of this study may be used for its contribution to provide some reasons on low implementation of compliance and its association with line management leadership and ownership. The recommendations resulted are to improve management ownership in asset integrity implementation by include asset integrity performances in management further to review the scorecard on a regular basis, and build up competence of maintenance engineers, standards, improves asset registration system by aligning all registration parties performances, and establish a clear role assignment between maintenance engineers and support team.

Keywords: Asset Management Framework (AMF), Asset Integrity, Threats, assets, management ownership, and maintenance engineer competences
Background of the study

The study was conducted in one of the multinational mining company. This company is opened as one of the working contract holders of government in Indonesia, for mining of mineral Nikel. The area of mining contracts is approximately 230 thousand hectares, which stretches across three provinces on the island of Sulawesi, namely South Sulawesi, Central Sulawesi and Southeast Sulawesi.

During the 30-year period, the company has processed approximately 65 thousand hectares of land concessions and in the period of the contract of work the 2nd stage. One strategy of expanding production (growth) of the company is planning to expand its business by establishing additional processing facilities smelting in the concession area at a distance of approximately 80 km from Sorowako. Certainly this extra facility would need an integrated asset management strategy and integrated business strategy. Judging from the age of companies that have more than 35 years of operation and supported operating environment conditions pyrometallurgy of course on all physical assets.

The company has experienced decay (deteriotisasi) both in terms of dimensions, the power of design, and performance, resulting in decreased integrity. Consequently the board of directors has implemented a strategy Asset Management Framework (AMF) in which there is Asset Integrity Management which began in early 2007 with the aim of ensuring the integrity of the company's assets to reach the target age and performance as expected. However, different record events (property damage incidents) during the period of last three years indicating that the implementation of asset integrity management has not resulted in performance as expected.

Thankfully the incident does not cause injury to person (injury), only resultred material loss of equipment, as well as loss of opportunity on productions. Though, the loss is of great value. In June 2007, Flux Bin in the melting furnace collapsed due to structural decay and further due to excessive corrosion. Additionally explained, data management section of maintenance is not detailed and describes treatments that have been carried out on the supporting structure, but equipment. This
incident is one of the proofs that explain the existence of disparities in
the implementation of asset integrity management.

Another event, fracture of steel structures stacker conveyor screening
station no 8 occurred around June 2008. This incident is almost the
same failure mode where the corrosive environment on the sidelines of
the connection structure, resulting in a concentration point perkaratan
high rate. Thus, a peak at point threshold rust cause broken
on the conveyor structure circuit connections and lead to high
repair costs enough. Some of the other events in the same period of
2008 to 2009, successively in the form of burning Furnace
Transformer, Roller Thrust Shaft breakage, and a few other events,
have indicated the need for re-evaluation the scenario, inorder to see
how the implementation of asset integrity management works
in the company.

From the explanations above operating conditions, the experiences of
major events in the period of 3 (three) years back, the implementation
period of Asset Integrity Management (AMF), and vision - operational
mission work contract in the future, it needs to be studied further by
conducting research evaluating the implementation of Asset Integrity
Management strategy that will provide the basis for the board of
directors to establish a plan and that appropriate measures for the long-
term viability of asset-its assets in order to meet customer satisfaction.

Problems

1. How to implement Asset Integrity Management in the company if
   it is in accordance with the discretion that, in this case Policy set
   forth in the Asset Management Framework?

2. What are the steps that must be done by the Management that
   wisdom Asset Integrity accordance with policy- set?

Case research objectives

1. To evaluate compliance (compliance) Asset Integrity
   Management strategy implementation
2. Generate recommendations to management to improve the implementation of asset integrity in line with company policy.

Based on the purpose of the research, the expected benefits:

1. For the board of directors has the information or images regarding compliance (compliance) application of the implementation of asset integrity management program and get recommendations for company business to ensure

2. For the scientific field of maintenance management is to add a method to evaluate the implementation of the program Asset Integrity Management.

LITERATURE REVIEW

Understanding Asset Integrity Management

One program that has now become standard in the industry for mineral, oil, and gas in the last 10 years is that there is a comprehensive program that regulates the survival of the integrity of the production equipment, known as Asset Integrity Management. With this program, long-term sustainability of operational assets - asset critical company can be implemented properly, and a guarantee for all stakeholder to avoid the consequences of failure are major threats. Asset Management Framework (AMF) described one asset maintenance strategy is to perform Asset Integrity Management program. The program is more geared to the long term strategy of assets in order to avoid the consequences or the risks associated with failure is the failure of major (McAlear, 2006).

In the explanation of the AMF, the work of service (service) as work that is not directly associated with the production, but must be completed for operational continuity of production in the future. Service in this case includes all the maintenance work (maintenance) of the assets and the working environment and all routine operations including preparation and setup work necessary for production. Some component- asset generating modes of decay are of a
relatively very short, as in a matter of days, weeks, and months. Part of maintenance involved in operating the assets are very familiar with the natural conditions and causes of failures of this short-term because of the repetition frequency is very short. As a consequence, short-term failure is likely to be preferred for the preparation of models of assets. Models are often used to cope with the consequences of this failure mode is a model approach to maintenance routines.

After a period of operating assets in tens of years, such as building structures, pressure vessels is high, the transformation of the electric current is strong, there will be a concentration of pressures from environmental, operational, and maintenance, resulting in decay to a point where the possibility of failure will occur, or changes in technology that led to the assets obsolete (absolutely) no longer maintained. Indication of the failure of these assets very slowly and tend to insensitiveness. This implies that:

- From some experience frequent failures do not realize or understand the causes of the failure. Some of the decay mechanism but observes. When the mechanism can be seen and felt, tend to be perceived decay is very slow and did not realize also the addition of decay serve targeted. Often if conditions realized there was a tendency that the consequences have not occurred, control action is often delayed due to the slow decay.

- For some components of assets, there are a few points decay after repair, which replicates repair impracticable and just overall replacement (replacement unit) is more economical to do. If a failure occurs in the main components will arise concerning the type of the failure of major safety problems (safety), the-environmental, production or a huge cost (significant cost). It is thus necessary specifically outlined maintenance program that can provide long-term security in terms of safety, cost effective, and so forth in which Integrity there is integrity of Asset (Asset Integrity Management).

- Sandy Dunn, in his book A Integrity- Ensuring Asset Risk Base Approach, said that, "There are many methodologies and techniques to improve the reliability and availability of assets, including examples of the techniques of Reliability Centered
Maintenance (RCM), PM Optimization, Analysis Weybull, etc. However, all these techniques have a major drawback when companies face the consequences of failure that are major, the chances are very small, and these failures resulted in a very large impact on the integrity of the assets of the company”.

Lebih further explained that the main objectives of asset integrity management are: “To ensure the continuity of the commercial aspects of the company's operations in a manner to ensure that any risks - risks associated with the failure of a major nature of the assets in the level tolerated by the company or at a level that is acceptable to all elements of the community” ... (Picknell, 2002). This asset integrity management is developed also of management science (risk management) in the context of risk operating physical assets.

Some definitions risk proposed by Vaughan (1978) as follows:

Risk is the possibility of loss (risk is possible losses). The term possibility means that the probability of some event between zero and one (or may not occur);

Risk is uncertainty (risk is uncertain). Uncertainty can be of subjective and objective. Subjective uncertainty is individual to situations based on the knowledge and attitudes of individuals / entities of the group concerned. Each individual or group of entities (organizations or companies) has a risk level that is different. Risk can occur in service, performance and reputation of the institution concerned. Risk that can occur due to various internal and external factors, among others, natural occurrences, operational conditions, people, politics, technology, employee, financial, legal, and management of the organization.

Risks that occur in the company concerning: a) the risk of production (production), namely asset failures that led to the assets mentioned could not produce charcoal production or services to be expected; b) the risk of environmental, that is to say, asset failures which cause damage to the environment standards, regulations, and permits the company operates; c) the risk safety, namely the failure of assets that caused the accident, can even cause deaths (fatality) for
people in the vicinity; and d) poor living conditions
Health (health), the failure of assets that led to the exposure of a
dangerous disease for the life of the masses.

Asset integrity can also be defined as the ability of an asset to display
the required function effectively without causing injuries to life and the
environment. So asset integrity management can be defined as an order
to ensure the people, the environment is, processes and resources,
which perform integrity could be available and well organized, which
have the power to for purposes of integrity during the life
cycle (life cycle) of the equipment.

Asset Integrity Management Needs

Asset Integrity recently considered as one of the elements that are
essential to increase productivity. In its development, asset integrity
built to accommodate the technical problems of maintenance,
inspection and engineering assessment, up to a level of corporate
management policy. Objective of assets integrity management is to
maximize the value of the return on investment of the assets in its
efforts to maintain stakeholder values and minimize risk business risk
related accidents and loss of production. Objective of this carry profit
can be explained as follows:

1. **Improved Safety and Environmental.** By minimizing the level
   of risk and hazard exposure will protect all parties related,
   maintaining the reputation and nurturing community
   environment.

2. **Improved reliability.** Routine inspections are carried out will be
   able to avoid downtime asset unplanned (reliable). Thus it will
   not happen anyway unplanned intervention of the production
   process.

3. **Optimize maintenance and inspection** activities to achieve the
   targets EHS and business. Increased inspection activity
   reduces preventive maintenance program that reduces costs.

4. **Planning investment budget (capital)** much more concerted and
effective in the long-term deployment schedule.
Development processes Asset Integrity

As part of a management strategy, asset integrity management should melingkup policy development (policy), organizing, planning and implementation; performance measurement, audit and review, and continuous improvement (analyze and improve).

Figure 1 below shows the stages of the development process of asset integrity management.

![Standard risk management process (source: Broadleaf Capital International, Pty Ltd., 1999)](image)

**Element - Asset Integrity Management Competence**

Personnel with the level of competence required to be supported by a senior management commitment. A special team is required to
establish a system of competency standards that include verification through audits and training, the processes of recruitment, formal assessment, elaboration of tasks and authority, the approval of work, dealing with the standards of national or its equivalent, and well as third parties such as contractor.

1. Planning (Planning)

Asset integrity management requires implementation of comprehensive planning in order to run successfully.

Planning and implementation of asset integrity management should include:

a. The definition of the processes required to manage asset integrity.

b. The resources and the allocation of responsibilities.

c. Identification refers to the actual performance and the target (plan).

d. Identification of EHS necessary melingkup

e. Elements necessary business

f. Priorities and the effectiveness of each activity.

2. Quality and Audit.

Management and audit quality must be integrated and combined in every process and aspects of asset integrity. The quality and audit system is a framework for senior management to steer the company towards performance improvement through 4K guide called "control-control" (the definition of duties and responsibilities), "communication (clear reporting), “competence" (training and supervision), and "cooperated cooperation" (infrastructure management).

3. Measurement Performance

Achievement of asset integrity management can be measured through indicators such as KPI (key performance indicator). KPI definition in
this case is the performance management execution and asset ratios at levels above the level of threat that is tolerated by the company. Performance management is more focused on the execution of activities in the past schedules, commitment execution control, etc.

4. Routine Management (Management Routines).

Routine management is the process of interaction between all parties involved in the appropriate level and needs in the implementation of asset integrity to coordinate, evaluate or review, intervention and escalation to the next processing stage. Routine management is organized in a matrix form, it comes CPQQTR (context, purpose, quality, quantity, time, resources) that are defined and an indication of commitment and ownership (ownership) to the program.

5 CMS (Computerized Management System)

Asset integrity management is a long-term strategy that requires continuous process. In managing asset integrity management, computer-based infrastructure devices needed to cultivate and maintain continuity of data, documents, and standards necessary for the execution of asset integrity.

RESEARCH METHODOLOGY

Location and Time Research

This research was conducted in one of the multinational mining in the area Soroako, Luwu Timur, South Sulawesi. The location is focused on assets in Department Production (assets that relate directly to the production line. Research and data processing time for nine months from the month Februari 2010 to October 2010.

Types and Sources of Data

The type of approach employed in data collection is qualitative and quantitative. Source of data include both primary data and secondary data. Data collection is done through literature research, field research
(interviews and questionnaires), and downloading of information management systems maintenance management.

**Population and Sample**

As for the unit of analysis in this study is that bertuga's employees as a stakeholder role (role holders) at the Department of Maintenance (Maintenance Department). Based on the data of personnel until the end of January 2010 the number of stakeholders in the role of Maintenance Department 145 SEB many people. To determine the sample size used formula Slovin (Sevilla; 1993) so that the size of the sample obtained to 107 people that was distributed proportionally to all stakeholders role.

**Processes Assessment**

Stages of processes that are measured in the study in accordance with the stages of the process in figure 2 below:

![Figure 1. Process flows Asset Integrity](image-url)
Measurement Research

Data were collected from questionnaires and interviews subsequently measured at Pengu kuran method an audit of maintenance management weight:

- 0% (not done)
- 25% (conducted and no evidence)
- 50% (conducted and evidence is not complete)
- 75% (conducted and complete proof)
- 100% (done, full evidence, and most updates in the system used)

RESULTS

Descriptive result

Figure 2a and 2b. The level of education and number of respondents (sumber: data primary processed)
Research Integrity Asset Management Process

The results of the research processes of asset integrity management as follows:

![Bar Chart: Percentage of compliance with the implementation of asset integrity](image)

Figure 3. Percentage of compliance with the implementation of asset integrity (number: data primarily processed)

From the research results show that the processes of implementation of asset integrity management hasn’t reached the target set, that is, the minimum target of 90% compliance. Graphic above clicking describing compliance policy implementation of asset integrity management in the company for an average of 82%, with high adherence rates (high compliance above 90%) in the process of determining the criticality of assets, separation of financing, Opex and Capex, and management execution control action. This is because the company is a multinational enterprise open already introduced a system of international financial management, database criticality of assets either because they relate to tax audits and facilities Masterlist (free tax) document, and the company already mentioned very long time to execute all maintenance work. The process which has a low adherence (low compliance) is the process of implementation of routine management, updates to the database, the development of control strategies of action, threat identification.
and assessment, and data cleansing asset. In the subsequent discussion, it will only be discussed processes that have low adherence.

**Asset Integrity Performance PT. INCO**

There is several asset integrity management performance measured in accordance with the policy, namely:

1. Percentage availability of the control action for all threats on the old limit stipulated that the threat of business on 8 and EHS threat above 12 minimum of 85%.
2. Percentage of control actions completed on time before the maturity date was set at a minimum of 85%.

Hacyl research shows integrity threat picture company asset by assessment in 2007 as shown as below.

![Figure 4. The threat level asset integrity PT. INCO years 2007 to 2011 (source: data is processed)](image)

Total assets do as much as 445 asset assessment is divided into 430 assets belonging to the major threat levels and 15 assets classified as low threat level. Total threats is as much as 778, of which 426 have consequences that are in the EHS threat levels above 8, as many as 204 have business consequences over 12, and the remainder is under threat
levels tolerable companies. A total of 460 threats that have high levels of threat both (EHS and Business) above the limits in tolerance.

Figure 5. PT control action plan. INCO for EHS threat on the value of assets in the 8th. 2007 to 2011 (source: data is processed)

Figure 6. PT control action plan. INCO for business threats assets above the value of 12 th. 2007 to 2011 (source: data is processed)

Figures 5 and 6 show the threat of EHS assets worth over 8426 threats, and control the action provided much as 298, so that the action of the control percentage of 70% of the total threat. Total business threats is a valuable asset 12183 threats and control measures available as much as 102, so that the action of the control percentage of 56% of the total
threat. Thus the 80% target set by the company to control the availability of action has not been reached.

Figure 7. Plan and the actual completion of the action controls PT. INCO for EHS threats and business assets above the threshold limit of 2007 to 2011 (source: data is processed).

Figure 7 shows that a total of 400 control actions that had been set for overcome EHS threat or Business, just completed its execution before maturity as much as 292 control the action, so that compliance with this performance as much as 73%, below the target set at 85%.

Table 1. Obviously the cost components - asset integrity management enforcing the period 2007 to 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>MST Tasks</th>
<th>MST Cost ($)</th>
<th>Assessment Cost ($)</th>
<th>Control Action Execution ($)</th>
<th>Total Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>850</td>
<td>450,230</td>
<td>200,000</td>
<td>18,839,352</td>
<td>19,489,582</td>
</tr>
<tr>
<td>2008</td>
<td>925</td>
<td>610,050</td>
<td>0</td>
<td>9,751,600</td>
<td>10,411,650</td>
</tr>
<tr>
<td>2009</td>
<td>750</td>
<td>525,740</td>
<td>0</td>
<td>2,478,600</td>
<td>3,004,340</td>
</tr>
<tr>
<td>2010</td>
<td>800</td>
<td>475,000</td>
<td>150,000</td>
<td>1,432,000</td>
<td>2,057,000</td>
</tr>
<tr>
<td>2011</td>
<td>600</td>
<td>415,325</td>
<td>100,000</td>
<td>5,000</td>
<td>520,325</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>35,482,897</td>
</tr>
</tbody>
</table>

Source: Data processed
Total losses cost consequences can be avoided by the company to carry out the implementation of asset integrity management well are as follows:

Table 2. Cost consequences avoided by PT. INCO to carry out asset management policy integri bag the period 2007 to 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>Implementation Cost ($)</th>
<th>Consequence Cost ($)</th>
<th>Cost Avoidance ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>19,489,582</td>
<td>88,768,000</td>
<td>69,278,418</td>
</tr>
<tr>
<td>2008</td>
<td>10,411,650</td>
<td>65,004,500</td>
<td>54,592,850</td>
</tr>
<tr>
<td>2009</td>
<td>3,004,340</td>
<td>18,003,400</td>
<td>14,999,060</td>
</tr>
<tr>
<td>2010</td>
<td>2,057,000</td>
<td>14,003,400</td>
<td>11,946,400</td>
</tr>
<tr>
<td>2011</td>
<td>520.325</td>
<td>1,582,000</td>
<td>1,061,675</td>
</tr>
<tr>
<td></td>
<td>Total Cost Avoidance ($)</td>
<td></td>
<td>151,878,403</td>
</tr>
</tbody>
</table>

Source: Data processed

DISCUSSION

The results showed the asset integrity management implementation has not been done properly in accordance with the targets set by the company. The research found compliance with the implementation of asset integrity management policies by 82%, with high adherence rates (minimum compliance 90%) in the process of determining the criticality of assets, separation Opex and Capex financing, management and execution of the control action. The processes which have low compliance is the process of implementation of routine management, updates to database, development of control strategies of action, threat identification and assessment, and data cleansing asset. In the subsequent discussion, it will only be discussed processes that have low adherence.
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The risk management must engage in communication, monitor, and evaluate on an ongoing basis. Performer’s right to perform this process is the information management area. Routine management processes are fully integrated and sustainable This shows the level of leadership (leadership) and possession (ownership) which is owned by the management of this policy. To cultivate leadership can be done by way of educational skills and knowledge to the management of asset integrity management and apply the card model performance (score card) organization at the company. Research in the field showed company's own management information system scorecard structured evaluated on a regular basis (weekly, monthly, etc.).

Unfortunately none of that asset integrity management performance is an entry in the items discussed scorecard. If the dangerman company Key Perforemance Index asset integrity is an important program and objective view regarding the company's future strategy, should be included in the scorecard. Another weakness is found in the process of administration of all routine and consistency of document management implementation. No one is dedicated specifically to organize the implementation of this process. When this study, each support team is organizing its implementation but the task is not defined clearly so attached to the role to support team. AMF in
In accordance with the basic principles, "shared accountability is no accountability," so we see in this case pertained share accountability. For that we need the dedication of people who are assigned to organize the implementation of routine management of asset integrity.

Table 3. The fulfillment of the schedule of routine management of asset integrity PT. INCO January 2009 - August 2010

<table>
<thead>
<tr>
<th>Meeting</th>
<th>2009</th>
<th>2010</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review Progres Budget Operasional dan Master Schedule</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Update Assessment dan Scoping</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Meeting Review Ancaman (Threat) Integrity</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Meeting Review Integrity oleh Senior Management</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Meeting Budget Tahunan</td>
<td>x</td>
<td>50%</td>
<td></td>
</tr>
</tbody>
</table>

Source: Data processed

The level of adherence to renew database system low is because the time to do the research found most support team is still much to give more priority to the use of user data in the form of Excel tables and the data updating process lasted only one direction without any process of review and monitor its sustainability. When doing research, there is no regular reporting on their progress in the process of entering data into the asset integrity management systems put in place. In accordance PDCA theory applied in asset integrity management, process check should be done by monitoring every activities and fulfillment of the performance of scheduled jobs to be carried out continuously. In this case, line supervisors and management as asset owners who acted as a customer of the field perpetrators routinely have to control the continuity of the data integrity of these assets. Repair system is necessary so that online system capable
of issuing a notification to the management if there are any changes in the data database asset integrity management system.

Another weakness is found, the role of his support team has nature constitutes task side (temporary) and the team's performance is not included in their annual performance evaluation targets (annual incentive plan). Thus, the implementation of integrity management gets a lower priority compared to their primary role. For it, it is recommended that the implementation of asset integrity management included in the annual performance evaluation of each support team so that his achievements have equal priority with other tasks.

Implementation of the strategy development process control action is very weak, especially in the identification process control strategies for action. In determining control strategies of action, skill and knowledge required capabilities in knowledge of maintenance. Competence is one of the elements that must be met in the preparation of the control strategy of this action. Further research, only a part of the maintenance engineer who received formal training in basic knowledge and theory failure maintenance strategy development and maintenance Parts Company does not have a standard of competence for the maintenance engineer, so many find obstacles in determining the control strategy of action.

Only some of the maintenance engineer who has completed the necessary competencies in asset integrity management are met by each department area. Recommended for re-mapping and develop basic competencies that must be owned by all the maintenance engineer Companies and incorporate integrity management competency requirements into the standards of competence. Low adherence in the process of threat identification and assessment due to low ownership (ownership) this program on the lines of management and the ambiguity of duties and responsibilities to undertake assessments on a regular basis. When doing research, facts on the ground found no indication that shared responsibility (shared accountability) between the maintenance engineers with the support team. It was therefore recommended that lines of management to delegate the task clear to assessment of asset integrity.
Data cleansing assets mainly in the registration process and the determination of the group in charge of operations / maintenance is very low due to the various parties involved (engineering, maintenance, and supply chain) respectively using the system and a separate module with a performance that are not interconnected, so that the transfer process information or data is done manually. Each stage of completion of the asset acquisition projects, not determined from the beginning who later as the maintenance and the supply chain does not have the same data project completion so that a lot of data that is not registered and renewed well in their respective party systems related, For it is recommended that all parties concerned to use linking systems and performance measured between one and the other should be interconnected.

Implementing a policy of asset integrity management that has lasted almost four years has not met the compliance of the targets set, with a level of compliance that is lower in the processes of implementation of routine management, consistency of database updates, strategy determination control action, the determination of the responsible party operations and maintenance and implementation consistency assessment field. The main cause of the low compliance of this process are: a lack of leadership and ownership of the line and not the implementation of the performance management of asset integrity into management scorecard, not the standard of competence for the maintenance engineer in terms of asset integrity, asset registration system is not comprehensive without involving all the parties organizers assets, and the absence of a clear delegation of the support team and maintenance engineer.

**RECOMMENDATIONS**

Suggestions have extended for improving the implementation of asset integrity management is:

1. Application of regular management consistently and include asset integrity management performance management scorecard for on-evaluation periodically in line management companies.
2. Development of competency standards for maintenance to be tailored to the needs of asset integrity management competencies, as a standard for the development of employees in order to improve asset integrity realisation.

3. Clear delegation of tasks between the maintenance engineers with a support team in the implementation processes of asset integrity management.

4. Construction of the system of registration of assets that connects all systems related parties in registering assets (engineering, maintenance, and supply chain) and the performance of all parties in terms of registering their assets so interconnected with each other mutual support.

CONCLUSION

Due to time constraints, this research could be developed further in order to study a form or chain management performance asset integrity to connect between the engineering, maintenance and supply chain, as each has a model achievement of different performance, where the engineer specifies how achievement performance based on cost, quality, and duration of the completion of the project, part of maintenance define, how the achievement of performance based on the current conditions and long-term viability of operational tools (uncertainty). While the supply chain mining companies are generally located in remote areas define how to achieve performance through control of the availability of goods and min-max needs of customers measurable (certainty). These three things are needed to make a well-integrated system.

REFERENCE


