

Conference Paper

Cost Benefit Analysis of Residual Risk Control in General Engineering Department of PT PAL Indonesia (Persero)

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Abstract

One cause of the low impact of Occupational Safety and Health (OSH) on the industry is the implementation due to cost, not as an implementation to save workplace accident. Because of that, we need a method to assess the implementation of OSH not only about cost, but also the benefit. One of the method that can be used is Cost Benefit Analysis (CBA). The objective of this research was to analysis CBA of residual risk in the Division of General Engineering of PT. PAL Indonesia (Persero) and provide the most favorable residual risk control based on CBA. The method was descriptive research. The result showed that the Division of General Engineering had been doing risk management starting from hazard identification, risk assessment, and risk control but still leaves residual risk that cause potential workplace accidents. Based on CBA, it showed that the three residual risk control programs, namely, OSH training, personal protective equipment (PPE) supply, and 5S implementation had NPV > 0 (positive) and B/C Ratio > 1. But, the highest B/C Ratio by 5S implementation. So, it can be concluded that the 5S implementation gives more advantages than the other options.

Keywords: cost benefit analysis, occupational safety and health economy, residual risk control

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1. Introduction

Workplace accidents are one of the biggest concerns in the world of occupational safety. This is due to the various losses both directly and indirectly affecting the worker and workplace. Based on data from PT Jamsostek in 2011 that there are 96,314 workplace accident with 42 disability worker and died as many as 21,444. The number of accidents each year has increased 5–10 percent [1]. This work accident can be caused

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by several things. The cause of the work accident is 88 percent caused by the unsafe action, 10 percent by unsafe condition, and 2 percent by unavoidable [2, 3].

One effort to reduce unsafe action and unsafe condition as the cause of work accident is with risk management. Occupational Safety and Health risk management is an effort to manage health and safety risk to prevent undesirable, comprehensively planned, and structured accident in a good system. One of the benefits of applying risk management is to facilitate cost estimation [4]. As we know that people think mostly that OSH implementation in the workplace will cost a lot of money. However, on the other hand, there are safety values for workers, jobs, and companies that can be saved by OSH implementation in the workplace. One of the causes of low awareness of OSH in the industry because the OSH's implementation is often regarded as cost, not as an investment to prevent accidents [1].

Since OSH still considered a cost burden, a method to assess the OSH's implementation is not only about cost, but also benefits. It can be used Cost-Benefit Analysis (CBA). CBA is a tool that can be used to decision making by looking financially at the cost incurred and benefits to be gained and to compare them in quantity. CBA also one of the economic aspect that affects risk control options in addition to other options (legal and social consideration) [5].

The purpose of this study is to perform Cost-Benefit Analysis (CBA) on residual risk control in the GE Department and provides the most favorable residual risk control based on CBA results.

2. Methods

This study was a descriptive research that was conducted by GE Department. Primary data collection was obtained through observation and interviews with related parties to obtain information on work accidents, OSH programs, risk management, and expenses on risk control performed in GE Department. The secondary data obtained from the literature study/document study. The steps in conducting CBA were as follows:

1. Identify all costs and benefits associated with any corrective actions taken as follow as:

- (a) Investment Cost (IC)

IC was the cost incurred to support the implementation of the program which included facilities and equipment purchase cost. The lifetime of IC was more

than 1 year generally. Total IC during 10-year project run (in Rupiah per year). The sources of investment cost in this study were:

- i. The total IC was derived from the proposals for submission of the budget for GE Department in 2017 and interview with the Head of OSH Bureau.
- ii. The calculation of investment IC by researchers were:
 - A. Identify IC
 - B. Calculate the total IC by summing up all the IC costs used.

(b) Operating Cost (OC)

OC was the cost incurred in the implementation/operation of the program. Total operational cost for 10-years of the project (in Rupiah per year). The sources of operational cost in this study were:

- i. The OC was obtained from the budgeting proposal by GE Department interview with the Head of OSH Bureau
- ii. Assumption of the inflation rate of the operational cost increase of 5R implementation was 10 percent.
- iii. The calculation of OC by researchers were:
 - A. Identify OC
 - B. Calculate the total OC by summing up all the OC costs used

(c) Maintenance Cost (MC)

MC is used to maintain facilities used on existing programs. The MC was calculated by researchers using formula = $5\% \times AIC$. While total MC was obtained by summing up all MC used.

(d) Damage and Loss

The cost of damage and losses were the cost incurred due to damage and/or loss of facilities during the program. The cost was calculated using formula = $10\% \times AIC$. While the total cost of damage and losses was obtained by adding up the total cost of damage and losses used

(e) Benefit-Cost (BC)

BC was derived from the same cost assumption from similar case company with PT PAL Indonesia (Persero) especially in GE Department as a manufacturing company and shipyard. The following were the cost of 4 cases of work accidents the form of electric shock with fire, falling from a height, falling material, and accidents during engine maintenance. The cost of this benefit is obtained from the results of the study by Hrymak and Perezgonzalez [6].

2. Perform the cost of each alternative

After all cost components were identified and classified, then the total cost of each intervention was calculated. How to calculate total cost was the same as in unit cost calculation. The calculation of them required the calculation of AIC (Annual Investment Cost) was to compare the cost of goods investment according to the life of goods with the formula:

$$AIC = IIC(1 + n)^k \quad (1)$$

The calculation of non-investment cost by adding up the total cost per year. The final result of the sum of all cost is Present Value Cost (PVC) or total cost was:

- (a) The present Value of Total Cost was all costs incurred to support the residual risk control program which derived from total cost using discount 13 percent and assumption of inflation rate 10 percent per year.
- (b) The present value of Total Benefits was all cost incurred to support the residual risk control program which derived from total cost using discount 13 percent and assumption of inflation rate 10 percent per year.

3. Transform the benefits to money and calculated the total benefits.

Direct benefits could be qualitative and quantitative in output, while indirect benefit was from the other project, but as an impact of the project [5]. The result of them was the amount of direct and indirect benefits as Present Value Benefit (PVB)

4. Calculating Net Present Value (NPV)

NPV was a difference between the benefit obtained with the cost incurred by the formula:

$$NPV = \sum PV \text{ Benefit} - \sum PV \text{ Cost}$$

The interpretation of NPV results is as follows:

- (a) If the $NPV > 0$ (positive NPV) this means that the total benefit is greater than total cost, so the project (rehabilitation, expansion) was called favorable.
- (b) If the $NPV = 0$ (neutral NPV), then the total benefit was only sufficient to cover the cost during the technical-economical life of the project.
- (c) If the $NPV < 0$ (negative NPV), then the benefit was not sufficient to cover the cost during the technical-economical life of the project was called unfavorable.

5. Calculation the B/C Ratio

The B/C Ratio showed the comparison between benefits and cost incurred by the formula:

$$B/C \text{ Ratio} = \sum PV \text{ Benefit} / \sum PV \text{ Cost}$$

The interpretation of B/C Ratio results were as follows:

- (a) BCR > 1, the benefits were higher than cost, then the proposed corrective action was given a high priority assessment.
- (b) BCR = 1, benefit equals cost, the proposed corrective action was given a low priority assessment

BCR > 1, the benefit was lower than the cost, then the proposed corrective action could be implemented at work high risk and financial factors could be ignored.

3. Result

Based on calculation we did, it could be presented:

3.1. Net present value (NPV) on residual risk control

Based on the calculation of Present Value of each residual risk control alternative OSH Training, Procurement of Personal Protective Equipment (PPE), and Implementation of 5R had NPV > 0 (positive NPV). This showed that the benefits of them were greater than the cost, so the residual risk control alternative was a decent program to do and continue (Table 1).

TABLE 1: Net Present Value (NPV) of the residual risk control alternative programs.

The residual risk control alternative programs	NPV (Rp)
OSH Training	44,915,785,204
Procurement of PPE	50,714,238,460
Implementation of 5R	113,591,999,512

3.2. Benefit and cost ratio (B/C Ratio) on residual risk control

Based on the calculation of cost and benefit value of each residual risk control alternative showed that had B/C ratio > 1. This indicated that the benefit value was greater

than that the cost. However, the highest B/C ratio was the implementation of 5R, so it could be concluded that the implementation of 5R was more profitable than the others (Table 2).

TABLE 2: Ratio Benefit and Cost (B/C Ratio) of the residual risk control alternative programs.

The residual risk control alternative programs	B/C Ratio (Rp)
OSH Training	20.79
Procurement of PPE	53.57
Implementation of 5R	84.95

4. Discussion

The implementation of OSH should reflect the economic value as the core of the business, whether it can be shown or express a direct advantage in the calculation of money, or other benefits that can affect workers, management, and clients. Safety valves are not transparent to the company frequently, so the economic (money) aspects sometimes become obstacles to OSH implementation [7].

Therefore, CBA conducted to determine the value of safety or benefit of various OSH programs. Based on the result of document studies, there are budget plans for OHS programs, but the cost aspects still become a consideration in its implementation, given that it is quite high. Nevertheless, the management still provides the budget, not 100 percent, but only about 50–60 percent of the total budget plan.

4.1. OSH training

Based on CBA results that NPV is positive values which means that this program is favorable to proceed. In addition, B/C Ratio shows that the value of benefits obtained from procurement of PPE is greater than the cost. If we see the PVC, the cost of OSH training still enough high. Nevertheless, the safety awareness/OSH training program cannot be done, proved by NPV and B/C Ratio with good values.

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new workers to understand the company's mission, the role of safety workplace make production increase. As for the old workers, it can refresh the previous OSH training [8]. OSH training is intended to improve knowledge, skill, attitude, and caring [7]. It is based that the causes of work accident are unsafe action with 3 factors:

1. Someone doing an unsafe action because they do not know, the person concerned does not know about hazard, regulation, or work safely so that they make mistake at work and it is carrying out the work accident.
2. Someone doing an unsafe action because of they unable to run the job. They know how to work safely, but the physical ability, technical ability, and non-technical ability not support.
3. Someone doing an unsafe action because they do not want to. They have been knowing and able to do the job properly and correctly, but they do not want to do the procedure.

This is also same with the results of the analysis of the causes of the work accident in GE Department. It is happening because the lack of skill using the tools, improper motivations, lack of concentration, failing to secure, not using PPE, inappropriate working positions, and others. Some of these cases occur due to unsafe actions that are harmful to workers and companies so that safety awareness/OSH training can be used to control the residual risk.

OSH training as one of residual risk control must have a good management. OSH Training is a system that must be integrated with other programs [7]. Therefore, before the preparation of OHS training program, it is important to know the overall description of the training elements needed for effective and efficient implementation, including top management support. The implementation of OSH training cannot be separate from management's role [9]. Their role is one of the commitments to OSH implementation in the workplace that supporting the necessary resources, like money.

In addition, OSH Training is also regulated in the prevailing regulations in Indonesia. Occupational Safety Law in Indonesia, as know as Undang-Undang Keselamatan Kerja Tahun 1970, concerns the importance of conducting OSH training and diseases at the workplace. In Chapter V Article 9 requires coaching in the workplace. Based on this, the OSH training as a guide to workers organizing is absolute to be done in the workplace and is mandatory. the implementation of OSH training is contained in government regulations and ministerial regulations which it requires the workers to attend certification training held by both government and private institutions [7]. So,

OSH training can be applied not as a cost, but the benefits or as an investment and also as a form of compliance with applying regulation in Indonesia.

4.2. Procurement of personal protective equipment (PPE)

PPE is one of the tools that have the ability to protect workers which can isolate part or all the potential hazard at the workplace. PPE is the last alternative in hazard control hierarchy. However, in certain types of work, PPE is very necessary such as construction, workshop, and others, including in GE Departments. The main task of GE Department is to do non-ship project development programs in accordance with established policies, in other words, this department relates to workshop and fabrications every day. Therefore, the use of PPE is indispensable in this department.

Procurement of PPE has been set up in Operational Standard (SO) of the company which includes: procedures for the supply and distribution of PPE. So far, the procurement of PPE is still considered as a cost by the company. This has an impact on the duration of the change of PPE which can be replaced once in 2 years, but in the current decision, the change of PPE is once every 3 years. However, if there is damage before the turn of PPE, workers can apply for PPE procurement. However, if workers are negligent or remove the PPE, then the change of PPE process will be the responsibility of the workers by replacing it with the same item or by cutting off their salary.

As one of the efforts to intervention the decision making of PPE, so the perception that PPE only about cost, so I present the CBA results is positive NPV. It means that the program or activity is profitable and feasible to be implemented. Although we do not know the initial profit obtained by this company in conducting this program. But the value of this NPV can indicate the various benefits of procurement of PPE, one of them is decreasing the number of accidents.

In addition, also obtained B/C Ratio that proves the value of the benefit is greater than the cost. As we described in the statistic about work accidents in GE Department that most of the accidents are related to PPE, for example: exposed to grams, exposed to welding, pinched, scratched, and knocked. So, it is appropriate to supply the PPE to protect the workers.

4.3. Implementation of 5R

Implementation of 5R can be interpreted as the use of the workplace to train the habits of workers in an effort to improve the work discipline [10]. The implementation of

5R is included in an eco-efficiency tools which is the concept if economic efficiency combines the concept of economic efficiency based on the principle of efficient to use resources, products with better performance using less energy and resources [10] The concept of eco-efficiency on 5R implementation in line with CBA result is positive NPV. It is mean that program is profitable and feasible to be implemented. Although we do not know the initial profit obtained by this company in conducting this program. But the value of this NPV can indicate the various benefits of this program. In addition, also obtained that B/C Ratio that proves the value of the benefit is greater than the cost.

The benefits of implementation of 5R are the creation of clean and pleasant workplace, the maintenance of equipment, work equipment, and building, the realization of the workers discipline to achieve the standard operations and the efficiency of each par [10]. Implementation of 5R can also be assumed as a prototype of total participation so that the final target of 5R can be achieved, which is to improve the character and dignity of the company and its employees and present an active organizational system.

The GE Department has done the implementation of 5R since 2007 and is often the first winner in 5R implementation. Implementation of 5R has the basic application of Standard Operational number 2 UA 052 on 5R, and commitment of management and employees of GE Department. The existence of the implementation of 5R makes it easy for 5R implementation. Supported by CBA result makes the program less valuable for expenditure only.

Based on observation, some of the 5R aspects need to improve, for example, the walking area inside the workshop, the barrier color of the goods and the faded safety sign and some items not placed in their place. Although the implementation, not maximum yet, GE Department often has the highest score when a 5R audit is conducted by OSH Department. This proves the worker's commitment to make 5R as a culture and train the workers to do safety behavior.

In addition, the results of this CBA can be used as one of the recommendations to improve various aspects of the improvements mentioned earlier. This is because the implementation of 5R has the highest value in NPV and B/C Ratio. It is mean that implementation of 5R is more advantageous than the other options, so it will be easier to apply for management.

5. Conclusion

Based on the results of CBA, it can be concluded that:

1. The residual risk control alternative programs are OSH Training, Procurement of PPE, and Implementation of 5R has a positive NPV, so they are feasible to be implemented and continued.
2. The residual risk control alternative programs are OSH Training, Procurement of PPE, and Implementation of 5R has B/C Ratio > 1 , indicating that they have benefits higher than the cost.
3. The highest B/C Ratio is owned by the implementation of 5R.

Based on conclusions, we can suggest that:

1. It is necessary to do CBA on all residual risk control alternative programs and do Cost-Effectiveness Analysis (CEA) to choose and assess the best program to do.
2. It needs to be attending from the management as a determinant of CBA so that OSH programs can be seen as a benefit and investments to prevent the work accidents.

Conflict of Interest

The authors declare that they have no significant competing financial, professional, or personal interest that might have influenced the performance or presentation of work described in this article.

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