Increased productivity through waste reduction effort in oil and gas company

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Abstract. National companies engaged in oil and gas activities in the upstream sector. In general, the ongoing operations include drilling, exploration, and production activities with the result being crude oil channelled for shipment. Production activities produce waste gas (flare) of 0.58 MMSCFD derived from 17.05% of natural gas produced. Gas flares are residual gases that have been burning through flare stacks to avoid toxic gases such as H2S and CO that are harmful to human health and the environment. Therefore, appropriate environmental management is needed; one of them is by doing waste reduction business. Through this approach, it is expected that waste reduction efforts can affect the improvement of environmental conditions while increasing the productivity of the company. In this research begins by identifying the existence of problems on the company related to the amount of waste that is excessive and potentially to be reduced. Alternative improvements are then formulated and selected by their feasibility to be implemented through financial analysis, and the estimation of alternative contributions to the level of productivity. The result of this research is an alternative solution to solve the problem of the company by doing technological based engineering by reusing gas flare into fuel for incinerator machine. This alternative contributes to the increased productivity of material use by 23.32%, humans 83.8%, capital 10.13 %, and waste decreased by 0.11%.

1. Introduction

Flaring are considered the single largest loss in many industrial operations, such as oil-gas production, refinery, chemical plants, natural gas processing plants, the coal industry and landfills. Wastes or losses to the flare include process gases, fuel gas, steam, nitrogen and natural gas [1]. In general, many flare gas comes from the process of exploitation of oil well both onshore and offshore [9]. A flare is normally visible and generates noise and heat. Low quality gas composition that is flared releases many impurities and toxic particles into the atmosphere during the flaring process. The burning of gas flaring produces combustion by-products such as CO2, CO and NOx that are emitted to the atmosphere [1]. Based on data release by British Petroleum its known that total global gas flare from oil production in 2008 reached 139 Billion cubic meter per year or equal to 13,448.61 mmscfd.[10] Burning flare gas aims to minimize environmental pollution, because if flare gas discharged into the air without being burned first can be a negative impact on the surrounding environment [8].

Waste gases are subjected to such a process either because gases are a waste or it is difficult to store and transport them. Non-waste gases are burnt off to protect the processing equipment when unexpected high pressure develops within them. Gas flaring in oil rigs and wells contribute significantly to greenhouse gases in our atmosphere [2].
The emission of greenhouse gases (GHGs) especially carbon dioxide ($\text{CO}_2$) has been reported to be the major factor behind recently observed changes in climate extremes such as storms, floods, and heat waves as well as increasing global temperatures and rising sea levels. Gas flaring impacts climate change by adding about 400 million tons of CO$_2$ in annual emissions [3]. CO$_2$ and CH$_4$ are GHG that, when released directly into the air, traps heat in the atmosphere. The climate impact is obvious, suggesting a great contribution to global GHG emission [13]. As a result of the environment, gas flaring has raised temperatures and rendered large areas uninhabitable. CO$_2$ emissions from flaring have high global warming potential and contribute to climate change. CO$_2$ emissions come from only combustion of fossil fuels for about 75% [14]. CH$_4$ is actually more harmful than CO$_2$, it has about 25 times greater global warming potential than CO$_2$ on mass basis [15]. It is also more prevalent in flares that burn at lower efficiency [13].

Based on the fact that one of the national companies in the oil and gas field proficiency activities in the upstream sector. During the production, produce some waste namely liquid waste, solid and gas. Liquid waste in the form of water, which made the process of treatment back to use again for all stations, while solid waste is in the form of mud to be processed back into use. From observations in the field to the waste gas in the form of gas remains (flare) which is produced from the oil production process and the earth and during this is done burning to free air.

Gas flare produced has not been fully utilized as an environmentally friendly alternative, this is due to the gas flare only thrown into the air by burning so that produce carbon dioxide emissions by 33.5 tons/day. Then, with respect to the composition and the potential for gas that is produced, This object is to increased productivity with utilize flare to be economical and environmentally friendly alternative. [4].

2. Research method
The following are the methodological steps conducted in this study:

![Figure 1. The methodological steps](image)

3. The Result

3.1. Measurement of productivity
The value of productivity can be obtained with the following formula:

$$P = \frac{\text{Output}}{\text{Input}} \times 100\% \quad [1]$$

By using the formula, the calculated results of the company's productivity value for period of January 2014 until June 2015 can be seen in Table 1.
Table 1. The Value of Productivity

| No | Output             | Input              | Value of Productivity |
|----|--------------------|--------------------|-----------------------|
| 1  | 205,747,717,271    | 21,000,000,000     | 9.80                  |
| 2  | 169,787,953,986    | 20,000,000,000     | 8.49                  |
| 3  | 199,054,241,922    | 21,000,000,000     | 9.48                  |
| 4  | 198,573,141,583    | 20,000,000,000     | 9.93                  |
| 5  | 196,946,043,423    | 20,000,000,000     | 9.85                  |
| 6  | 184,674,553,282    | 21,000,000,000     | 8.79                  |
| 7  | 184,674,553,282    | 21,000,000,000     | 8.79                  |
| 8  | 216,490,801,574    | 21,000,000,000     | 10.31                 |
| 9  | 203,497,987,261    | 20,000,000,000     | 10.17                 |
| 10 | 210,054,974,493    | 21,000,000,000     | 10.00                 |
| 11 | 190,721,930,159    | 21,000,000,000     | 9.08                  |
| 12 | 196,146,206,445    | 20,000,000,000     | 9.81                  |
| 13 | 211,143,576,117    | 21,000,000,000     | 10.05                 |
| 14 | 195,350,549,141    | 21,000,000,000     | 9.30                  |
| 15 | 218,407,061,892    | 21,000,000,000     | 10.40                 |
| 16 | 199,365,193,290    | 20,000,000,000     | 9.97                  |
| 17 | 198,610,000,817    | 21,000,000,000     | 9.46                  |
| 18 | 178,311,804,649    | 21,000,000,000     | 8.49                  |

After seeing the results of productivity calculations, it is necessary to evaluate productivity that aims to see the productivity changes that have been achieved in order to be further analyzed.

![Value Of Productivity From Jan 2014 until June 2015](image)

Figure 2. Value of productivity from Jan 2014 until June 2015

3.2. Identification of problem and cause

Identification of this problem is done by using the tool of cause effect diagram. This tool is used to identify the problem in detail so that the root of the problem you want to solve. In searching for the root source of the problem can be used using the Ishikawa Diagram obtained from the interview in the production section. Identification of causes can be seen in the following explanation of cause effect diagram on Figure 3.
3.3. Goal and target setting
Based on the identification of the problem described through the causal diagram it is reducing of flare gas derived from the production process into an economic and environmentally-friendly alternative in order to achieve zero flaring 2030.

3.4. Formulation of alternative remedial solutions
Compilations of proposed alternatives to consider environmental, economic and social aspects are as follows:

a. Purchased gas cylinders to third parties. The purchase of gas cylinders is intended to make the flare gas utilized as LPG. Based on pollution prevention hierarchy with recycling (material reused in the production process). Where waste of residual gas (flare) is compressed into technology in the form of LPG gas cylinders through a series of processes. The application of this technology is based on a study conducted by Sugito in 2011 with a feed gas derived from java field (Jambi) of 2 MMSCFD where gas flares produce LPG of 12.26 ton / day, condensate of 27.24 barrels/day and Lean gas of 1.75 MMSCFD [7].

b. The alternative with recycling technique makes it possible to utilize flare gas as incinerator engine fuel. Where incinerator machine is a solid and liquid waste combustion technology that comes from various industries, buildings and hospitals [11].

3.5. Alternative selection

3.5.1. Alternative Financial Analysis with Annual Worth
a. Utilization as mini LPG [12]

Benefit - cost analysis is estimated five years for utilization as mini LPG

\[
\text{Benefit} : \text{Savings (P/A,i\%n)} = \text{R} 312,890,688,000 \times (P/A,18\%5) = \text{R} 312,890,688,000 \times (3.12717) = \text{R} 978,462,372,793
\]
**Cost**: Initial investment + Operational cost \((P/A,i\%.5)\)
\[= \text{Rp} \ 2,368,101,600,000 + \text{Rp} 236,996,160,000 \ (P/A.18\%.5)\]
\[= \text{Rp} \ 2,368,101,600,000 + \text{Rp} 236,996,160,000 \ (3.12717)\]
\[= \text{Rp} \ 8,146,583,562,139\]

BCR index for utilization as mini LPG
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b. Utilization as Incinerator Fuel
Benefit - cost analysis is estimated five years for utilization as incinerator fuel

**Benefit**: Savings \((P/A,i\%.5)\)
\[= \text{Rp} \ 312,890,688,000 \ (P/A.18\%.5)\]
\[= \text{Rp} \ 312,890,688,000 \ (3.12717)\]
\[= \text{Rp} \ 978,462,372,793\]

**Cost**: Initial Investment + Operational cost \((P/A,i\%.5)\)
\[= \text{Rp} \ 8,028,165,600 + \text{Rp} 9,783,509,520 \ (P/A.18\%.5)\]
\[= \text{Rp} \ 8,028,165,600 + \text{Rp} 9,783,509,520 \ (3.12717)\]
\[= \text{Rp} \ 55,700,136,085\]

BCR index for utilization as incinerator fuel :
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### 3.5.2. Estimate the Contribution of Each Alternative with Level of Productivity

Table 2. shows contribution consideration at each utilization. The selected utilization as incinerator engine fuel with the index of BCR equals to 17.56 can be implemented as repair solution because it has a big contribution from every consideration to company and environmental performances.

| Contribution          | Utilization as mini LPG (%) | Utilization as incinerator fuel (%) |
|-----------------------|------------------------------|-------------------------------------|
| Productivity          |                              |                                     |
| Material              | 23.3                         | 83.8                                |
| Labor                 | 77.8                         | 23.32                               |
| Capital               | 0.6                          | 10.13                               |
| Waste                 | 0.1                          | 0.11                                |
| Carbon emission       | 97.9                         | 97.9                                |
| Community income aspect| 1.08                         | 1.00                                |
| BCR Index             | 0.12                         | 17.56                               |

### 3.6. Implementation of the alternative plan

After an alternative solution is available which has the greatest contribution to the improvement of productivity and environmental performance, the next is to drafting the implementation plan of the chosen alternative that is utilization as incinerator engine fuel.

Table 3. Implementation of Alternative Plan [6]
| Purpose | Goal | Action | Responsible Person | Implementer |
|---------|------|--------|-------------------|-------------|
| Reducing of flare gas derived from the production process into an economic and environmentally friendly | Zero flaring 2030 | Purchase of Incinerator Machine | Production | Administration and Financial |
| | | Provide training on incinerator machine operating procedures to workers in charge of the operation machine | Production | Production Workers |

4. Conclusion
The chosen alternative to decrease the amount of residual gas (flare) is as fuel in incinerator engine with index benefit cost ratio is 17.56. This alternative contributes to the increased productivity of material used by 23.32%, humans 83.8%, capital 10.13 %, and waste decreased by 0.11%.

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