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Evaluation and Analysis of Manhour Rate in Maintenance of Gas Turbine Engine for Industry

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Abstract. The industrial gas turbine engine maintenance unit PT XYZ has a significant difference in the rate of man-hours with its core business, namely the maintenance of airframe and engines. This study aims to determine the factors that cause differences in the rate of man-hours in the two units and provide suggestions for the rate of man-hours. This study uses the IATA Labor Rate and Productivity Calculation for Commercial Aircraft Maintenance to produce the rate of man-hours. The factor which most affects the difference in the rate of man-hours is the overhead. A breakdown analysis of the overhead cost is then carried out by comparing the costs contributing to overhead costs. The calculation results show that the rate of man-hours for aviation engine maintenance is USD 55.80, while for industrial engine maintenance is USD 16.22. In addition, the most contributing overhead costs are the costs of production facilities.

Keywords: *cost of goods sold; industrial engine maintenance; rate of man-hours.*

1 Introduction

The performance and availability of gas turbine engines are critical to the profitability of businesses in the industry. In this case, a treatment process is needed to maximize availability. Maintenance is the process of maintaining physical assets including all actions necessary to maintain and restore assets under certain conditions in [1]. Engine maintenance is necessary for three main reasons specifically operational, value retention, and regulatory requirement in [2]. PT XYZ is a Maintenance Repair Overhaul (MRO) company registered with the Director General of Civil Aviation as an Approved Maintenance Organization (AMO) CASR part 145. This company is one of the largest aircraft maintenance facility providers in Southeast Asia. With expertise in servicing aircraft engines with high maintenance standards, PT XYZ expanded handling industrial engine maintenance by establishing a Power Services division. Power Services provides services consisting of repair, modification, and overhaul maintenance for Industrial Gas Turbine Engines (IGTE) and Aeroderivative. Aeroderivative is an

engine that originates from the aviation industry as the prime mover of aircraft, but the basic construction has been modified by removing the bypass fan and adding a power turbine to the exhaust and widely used as mechanical drive-in oil gas application and power generation in [3]. Business diversification at PT XYZ began in 2006 with the goal of increasing the company's revenues in line with future business growth trends. However, it turns out that IGTE maintenance has a significant difference in the rate of man-hours compared to its core business, namely airframe and engine maintenance. Based on the data rate of man-hours at PT XYZ, aviation gas turbine engine maintenance is around $ 50 per hour. Meanwhile, industrial gas turbine engine maintenance costs around $16 per hour. This paper aims to identify the factors that cause significant differences in the two types of business maintenance and influence the rate of man-hours which will affect the cost of goods sold. The cost of goods sold will greatly affect the top-level management in determining the sales price strategy to the customer, it aims to find a selling price that maximizes profit for the company in [4].

2 Research Methodology

This study used the document IATA (International Air Transport Association) for labor rate and productivity calculation (quantification factors). This a guide for people working in an airline's technical operations finance department or an MRO organization to determine the actual labor rate as it applies to specific cases. This calculation uses activity to determine the cost as a more accurate and fair method when charging maintenance job orders based on the analysis of costing two maintained items in the same premise while consuming different overhead resources in [5]. This research began with a survey of companies involved in the maintenance of aircraft and industrial gas turbine engines, as well as conducting a literature study. Next, identify the factors that affect the rate of man-hours difference. After that, quantify the influencing factors by registering the capability of engine types in the industrial engine and aviation engine units, identifying differences in business processes in the two units, and conducting a cost analysis that causes rate differences using the IATA Labor rate and Productivity Calculation. This calculation begins with calculating the total hourly cost of employees, followed by calculating the total cost of employees for the year. After that, it continued with the calculation of employee productivity in a year. The next step is to calculate the productivity adjustment factor, which is the result of dividing the total scheduled work time by the total production time. Next, collect overhead allocation data by selecting data in the same year for both units so that the adjusted labor rate can be calculated. Thus, the rate of man-hours for the two business units is obtained. After getting the calculation results, it will be a breakdown of overhead costs by comparing the overhead costs of the two businesses and followed by conclusions and suggestions.

3 Result & Discussion

3.1 Industry Survey

Preliminary research has been carried out by conducting a survey at PT ABC as a comparison with PT XYZ, both of which are gas turbine engine maintenance companies for aviation and industry. The results obtained from the survey are that the rate of man-hours in the two companies is relatively similar. In industrial gas turbine engine maintenance, the rate of man-hours is around $ 16 per hour. While aviation engine maintenance is around $ 50 per hour.

3.2 Identifying Factors Affecting Rate Difference

The rate difference is affected by overhead costs. These costs are divided into two, namely operational costs, and facility costs. Operational costs consist of staff expenses, company accommodation, and other operational expenses. Meanwhile, facility expenses consist of depreciation, facility maintenance expenses, and rental expenses.

3.3 Identification of Differences in Business Processes

The results of the identification that the business processes in the aviation engine maintenance and industrial engine maintenance units are generally similar. Starting from maintenance requests, issuing sales orders, and repairs to testing. Figure 1 shows the shop visited maintenance process.

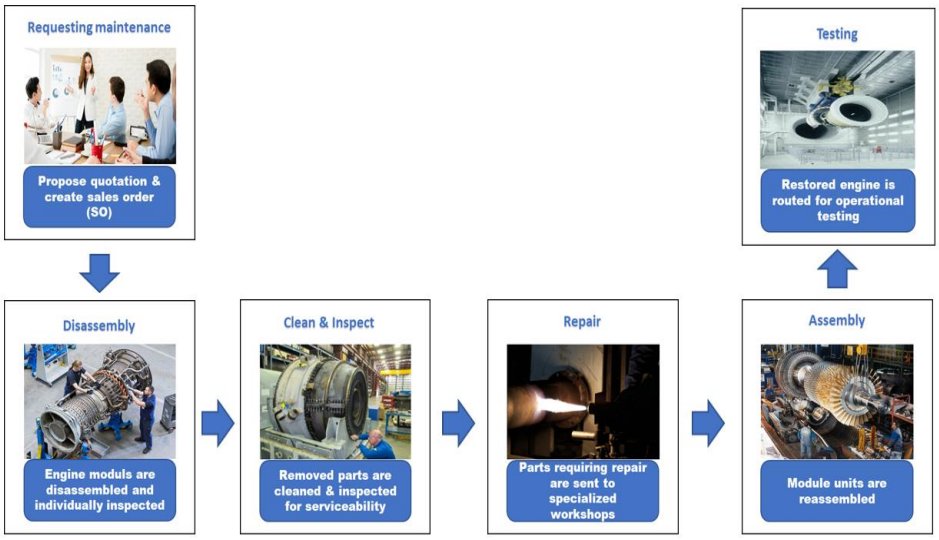

Figure 1 The shop visited maintenance process [2]

3.4 IATA Labor Rate & Productivity Calculation

This calculation gives a better understanding of how labor rate should be calculated in order to be used for: "Make vs. Buy" decisions, evaluation of profitability, and benchmarking purposes in [6]. Figure 2 shows the flow of calculating labor costs and productivity.

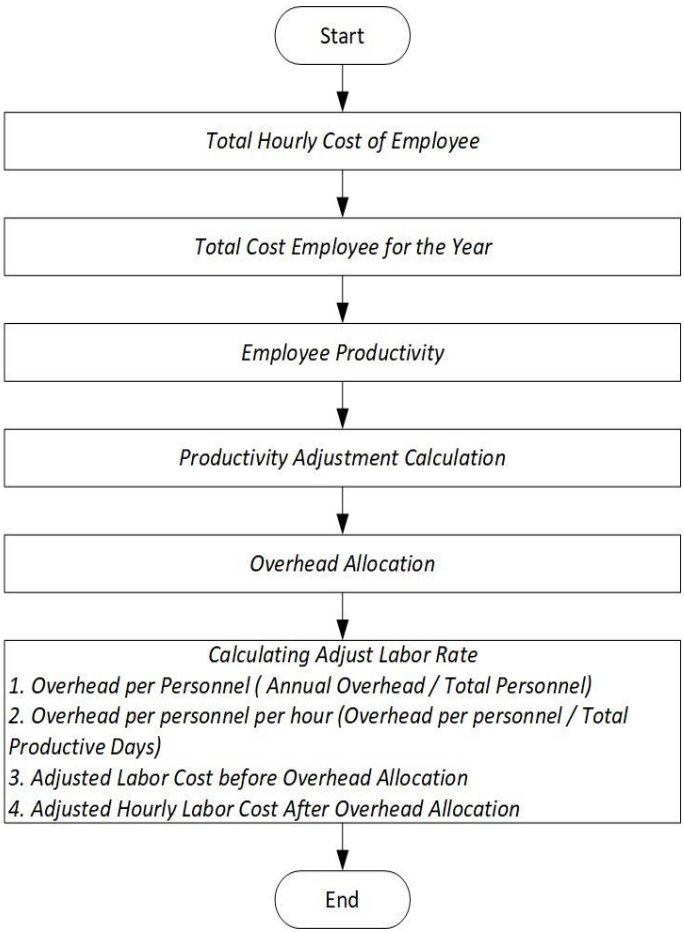

Figure 2 The flow of calculating labor costs and productivity [6]

The calculation results will produce the rate of man-hours. Aviation engine maintenance generates a rate of man-hours of USD 55.80 per hour, while industrial engine maintenance is USD 16.22 per hour. Table 1 shows the result adjusted labor rate that will determine the rate of man hours.

Table 1 Adjusted labor rate

	Aviation Engine (214 Labor)	Industrial Engine (112 Labor)
	137 Direct Labor	85 Direct Labor
Step 1 Overhead per personnel	USD 64,443.24	USD 17,933.46
Step 2 Overhead per personnel per-hour	USD 49.82	USD 11.83
Step 3 Adjusted hourly labor rate	USD 5.97	USD 4.39
Step 4 Rate of man-hours	USD 55.80	USD 16.22

3.5 Analysis of Factors Affecting Rate Differences

The analysis of factors is seen from the breakdown of cost by comparing the overhead costs of the two business ventures incurred regularly in the same year with the minimum, medium, and maximum maintenance work packages. In addition, there is a difference in the capacity of the facility, and has not used maximum capacity utilization in the two units.
From the calculation results, aviation engine maintenance has a higher proportion of man-hours rate than industrial engine maintenance. From the results of the overhead breakdown analysis, there are differences in the percentages of the two units. Aviation engine maintenance has an operating expenses percentage of 44% and facility expenses of 56%. Meanwhile, industrial engine maintenance has an operating expenses percentage of 83% and facility expenses of 17%.

Furthermore, it can be seen the breakdown of costs that affects operating expenses and facility expenses. The percentage for the breakdown also has a difference, operating expenses in aviation engine maintenance consist of 69% for staff expenses, 29% for other operating expenses, and 2% for company accommodation. Whereas in industrial engine maintenance, 76% for staff expenses, 19% for other operating expenses, and 5% for company accommodation. Figure 3 shows the breakdown of operating expenses for aviation engine maintenance and Figure 4 shows the breakdown of operating expenses for industrial engine maintenance.

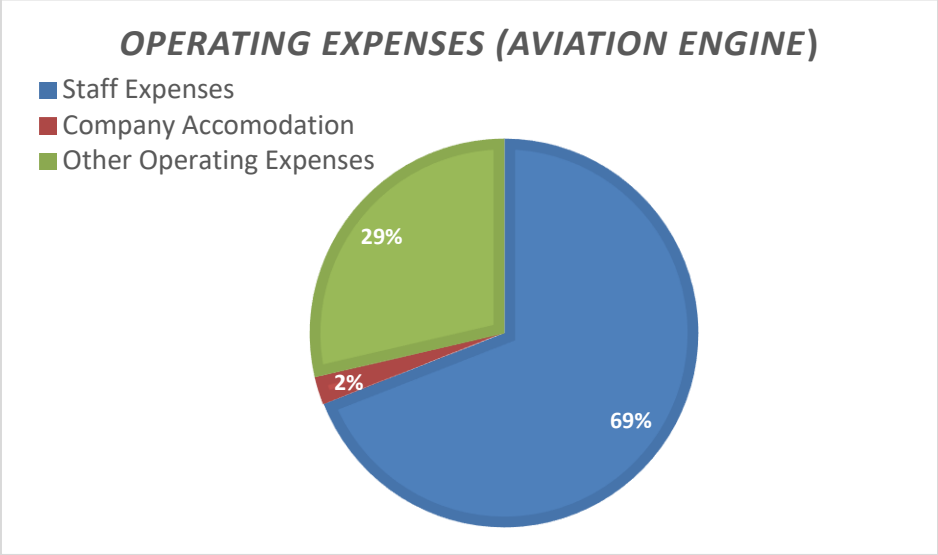

Figure 3 Operating expenses breakdown (aviation engine)

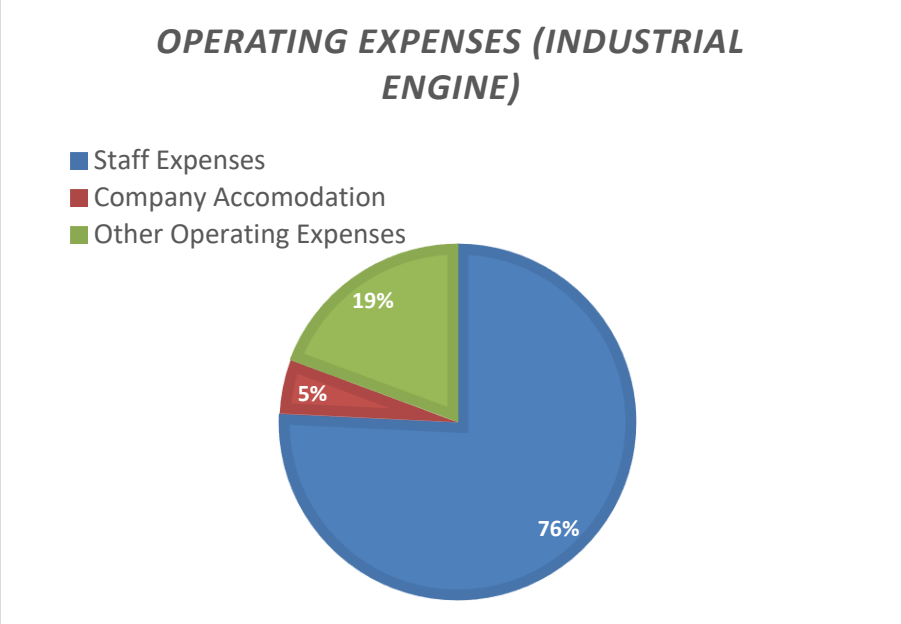

Figure 4 Operating expenses breakdown (industrial engine)

The breakdown cost of facility expenses, the percentage of aviation engine consists of 90% depreciation and amortization, 7% rental expenses and 3% facility maintenance expenses. Meanwhile, industrial engines consist of 57% rental expenses, 27% depreciation and amortization, and 16% facility maintenance expenses. Figure 5 shows facility expenses breakdown for aviation engine and Figure 6 shows facility expenses breakdown for industrial engine.

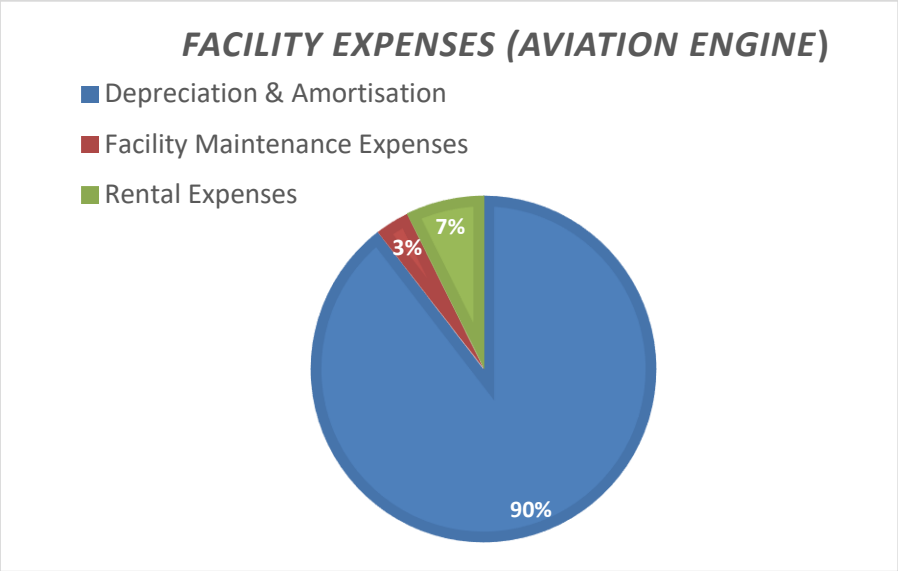

Figure 5 Facility expenses breakdown (aviation engine)

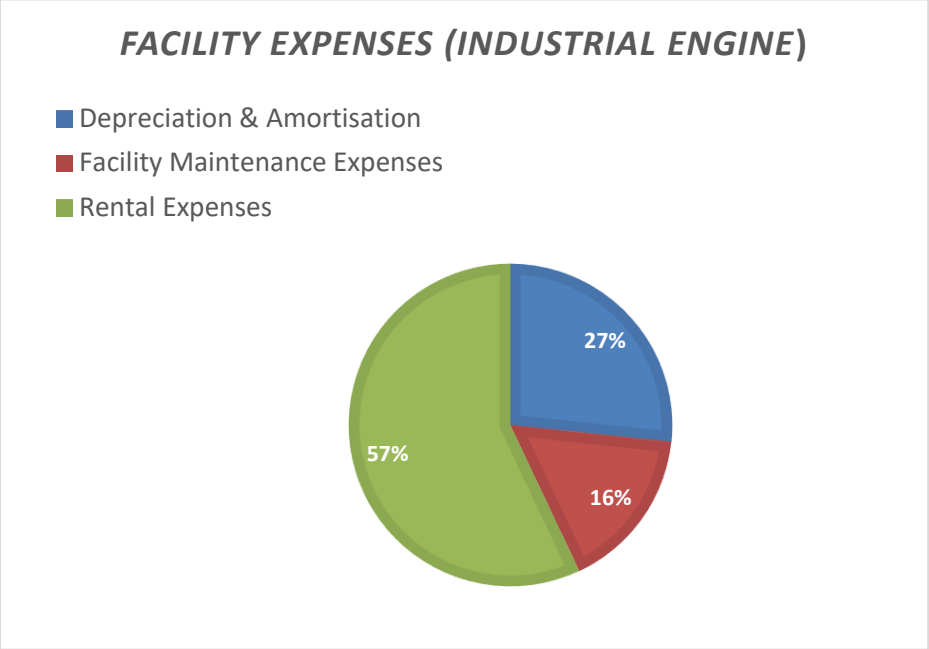

Figure 6 Facility expenses breakdown (industrial engine)

3.6 Analysis Result

From the results of the analysis that the most influencing factor is facility expenses. This effect is caused by significant differences in facilities and results in cost differences for the two units. In addition, different facilities will result in different depreciation. Having a variety of facilities will be directly proportional to the depreciation that will be issued. Another thing that can affect COGS is capacity. Maximum capacity will provide lower COGS because the facilities are utilized optimally and the contribution of facility costs is low per hour.

4 Conclusion

The results of this study are that the rates of man-hours for aviation and industrial engine maintenance of PT XYZ have similarities based on a comparison with PT ABC. Facility costs, which are part of the overhead, are a factor causing significant differences in the rate of man-hours in the maintenance of aviation and industrial engine. The calculation of the rate of man-hours for both businesses is USD 55.80 per hour for aviation engine maintenance and USD 16.22 for industrial engine maintenance. Facility costs as part of overhead are a factor causing significant differences in rate of manhours for maintenance of aviation and industrial engine.

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