*Jurnal Kejuruteraan dan Sains Kesihatan*
*Journal of Engineering and Health Sciences*
*Jilid 5 2021: 89 – 92*

# SMART OPTIMAL REPLACEMENT FOR HOSTEL MAINTENANCE MANAGEMENT BASED ON INCOMPLETE DATA

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***Article history:***
*Received : 26 November 2021*
*Accepted : 7 January 2022*
*Published : 24.January 2022*

ABSTRACT –The best times at which replacements action for building maintenance to execute need to be determined in order to minimize the total downtime and cost per unit time. The failure data is gathered during a selected period of time and if not sufficient, a subjective survey form and bootstrapping methods are used to support the incomplete information. The frequency of maintenance is identified by developing the intelligent optimal replacement model based on the cost and downtime value. The result shows that with the model maintenance staffs have additional features to support them in making maintenance decision.

**Keywords**: replacement model; building maintenance; intelligent model

## 1. INTRODUCTION

According to studies, the Hostel Maintenance Management (HMM) lacks a modelling method to identify the frequency of maintenance in a given period of time. The most important point of this problem is that it is concerned with identifying the best level of preventive maintenance (in this case, inspection and replacement). Whenever necessary, the replacement duration can be incorporated into the replacement model, as is required when the goal is the minimisation of total downtime or equivalent and the maximisation of item availability. There is a need to have an optimal maintenance strategy such as replacement, repair and inspection. Before any optimal maintenance strategy can be implemented, failure distribution and the parameters of the hostel component need to be identified [1]. The balance is required between the money spent on replacement and savings obtained by reducing the operating cost. The problem is to determine the best times at which replacements should occur to minimize total downtime and cost per unit time for hostels in Malaysia.

The HMM model seldom uses AI in identifying the frequency of maintenance. The AI technique can be incorporated into the replacement model, as is required when they try to minimise the total downtime or equivalent and to maximum item availability. There is a need to have an intelligent maintenance strategy such as replacement, repair and inspection. By enriching the model with AI, it is believed the accuracy of the result can be improved. The aim of this research is to propose an intelligent optimal replacement model. The model will aim to find the optimal replacement frequency by referring to cost and downtime values.

## 2. METHODOLOGY

In order to identify the constraint and limitations of the clear boundaries of this research, the scope of this research need to be determined. To develop and apply an HMM, a detailed research design is needed. The research design framework for this research is adapted from previous studies [1-4] as shown in Figure 1.

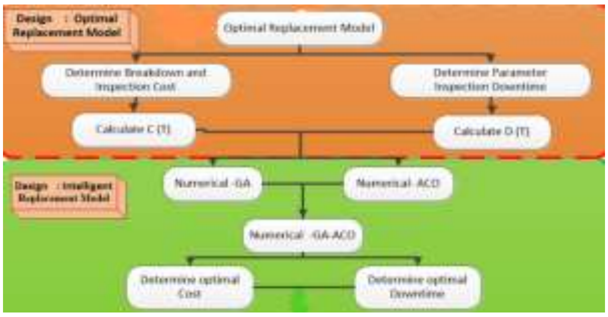


Figure 1 The proposed Methodology

The cost of an inspection and repair keep on increasing. This methodology demonstrates the concept for the use of minimizing downtime and costs, setting maintenance intervals to achieve the optimum. The methodology also demonstrates the use of analysis for a potential catastrophe resulting from failure of a piece of equipment or a component. The model also takes into account whether the damage from such a failure is reversible, and if so, at what cost. Information is gathered from historical

data as well as expert judgement. Parameters are established from this information in order to develop the models.

## 3. RESULTS AND DISCUSSION

The results and analysis structure of this chapter are shown in Figure 2.

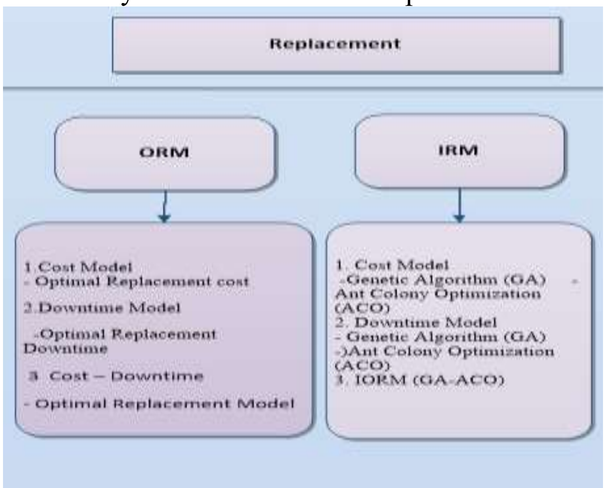


Figure 2 Result structure

Table 1 show the cost and downtime result respectively in Case Study. Meanwhile, Table 2, Figure 3 and Figure 4 show the cost and downtime result respectively. Able 1 Cost Downtime Intelligent Replacement

Model

| Time | Cost | | Downtime | |
|---|---|---|---|---|
| (Month) | (RM) | % | (Hours) | % |
| 1 | 170.99 | 8.58 | 132.725 | 34.7 |
| 2 | 170.81 | 8.5 | 72.8024 | 19.01 |
| 3 | 170.71 | 8.45 | 36.46075 | 9.53 |
| 4 | 170.64 | 8.42 | 19.3315 | 5.04 |
| 5 | 170.54 | 8.36 | 11.64375 | 3.04 |
| 6 | 170.38 | 8.29 | 7.889385 | 2.05 |
| 7 | 170.35 | 8.27 | 6.66608 | 1.75 |

| | | | | |
|---|---|---|---|---|
| 8 | 170.27 | 8.24 | 7.752824 | 2.03 |
| 9 | 170.23 | 8.22 | 8.528883 | 2.23 |
| 10 | 170.19 | 8.16 | 13.583 | 3.55 |
| 11 | 170.2 | 8.28 | 24.01941 | 6.27 |
| 12 | 170.25 | 8.23 | 41.48059 | 10.8 |
| Total | 2090.56 | 100% | 382.8836 | 100% |

The remarks that can be concluded are that the assumption is verified by the 2D curve that the best time for replacement cost and downtime plotted above the perfect replacement. It also shows that when the value from 19.33 to 170.64 and 13.583 to 170.19 the curve will go to the status quo point. If the quality of cost downtime is met, more faults are detected; the downtime will reduce due to fewer breakdowns occurring during operations.

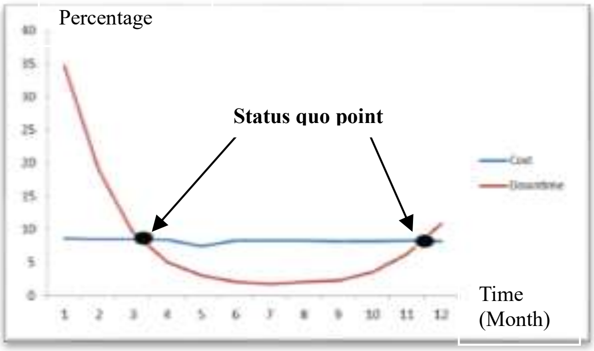


Figure 3 Two Dimensional Graphs (2 D): Cost-Downtime Intelligent Optimal Replacement Model

## 4. CONCLUSIONS

By determining the relevant replacement models and inspection intervals that optimise the cost downtime, obviously can improve the maintenance policy. There is an apparent increase in using intelligent approaches and utilising their combined strengths. There is enormous potential for developments in many applications of AI in maintenance by combining Genetic Algorithms (GA) and Ant Colony Optimization (ACO) techniques. Intelligent management systems (IMS) are potentially powerful tools that can help making best replacement models for HMM.

## 5. ACKNOWLEDGMENT

This paper is part of the KUIM Research Management Centre (RMC) and Faculty of Technology and Digital Media (FTMD), Kolej Universiti Islam Melaka (KUIM).

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