Application of genetic algorithm method on machine maintenance

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Abstract. This study aims to determine the optimal Hell Nailing machine maintenance schedule by using Genetic Algorithm method. This method can solve the problems faced by the company that is, often the occurrence of damage at the time has not been done back treatment, this research conducted at PT. Karyamitra Budisentosa which is a company engaged in the production of producing women's shoes with demand patterns in accordance with consumer demand. The variables used are machine maintenance optimization while the observation variables include data of damage time, data maintenance time, data setup machine data downtime. Data collected from interviews conducted at PT. Karyamita Budisentosa in the form of machine maintenance data. The result of this research is the optimal machine maintenance schedule in 1 year done 3 times.

1. Introduction

In a company we often encounter, the term maintenance is often translated as maintenance. Maintenance is the conception of all activities necessary to maintain or maintain the quality of facilities or machinery in order to function properly as the initial conditions. Treatment is also a supportive activity that ensures the continuity of machinery and equipment so that when needed can be used as expected. So that the maintenance activity is a whole series of activities undertaken to maintain the units in operational conditions and safe, and if there is damage then it can be controlled on the operational conditions are reliable and safe. Preventive maintenance activities can be categorized in one of two ways, component maintenance or component replacement. (Ebrahimipour et al, 2013; Alrabghi, A and Tiwari, A, 2015). Many maintenance-scheduling methods have been proposed using conventional mathematical programming methods or heuristic techniques (Ebrahimipour, 2013). Mathematical optimization based techniques such as integer programming (Ighravwe and Oka, 2014; Fetanat and Khorasaminejad, 2015; Mansini et al, 2015; Amaran et al., 2016), dynamic programming (Yin et al, 2016; Bertsekas, 2016) and branch-and bound (Lu et al, 2015; Silva et al., 2015) have been proposed to solve maintenance scheduling problems. PT. Karyamitra Budisentosa require many production machine one of them production machine that is Heel Nailing machine with machine age 7 years. Heel Nailing machine maintenance system used by PT. Karyamitra Budisentosa in one year is treated with the schedule of the month that has been determined by the maintenance that is 3 times in 1 year that is April, August and December, but in the maintenance done by the maintenance is still damaged ie damaged seals, piston seals, Coil and others. PT. Karyamitra budisentosa wants to determine the optimal machine maintenance schedule.
In machine maintenance systems, each machine must use an optimal maintenance system. In order to occur the product increase in production and no damage occurs when the production runs so as not to make the production process stopped. By using Genetic Algorithm method which produces optimal histori data from generation of number.

2. Literature and Method

2.1. Maintenance management
Treatment is a function of an important manufacturing industry such as other production functions. This is because if we have a machine or equipment, then usually we will still try to be able to use the machine or equipment to keep production activities running smoothly (Amiin, Waviy, 2011).

2.2. Planned maintenance
Maintenance planned is an organized maintenance that is done with the thoughts of the future, recording, and control in accordance with the plans that have been prepared previously. Therefore the maintenance program to be carried out must be dynamic and require supervision and control through information from the history records of equipment or machines. This concept aims to overcome the problems faced by managers with the implementation of maintenance activities. Communication can be improved through information capable of providing complete data for decision making. Important data on maintenance activities may be maintenance request reports, inspection reports, corrective reports, etc. (Shafiee and Chukova, 2013). Maintenance planned consists of three forms of implementation, namely: Preventive Treatment (Kaplanoglu, 2014; Liu et al., 2014; Liu et al., 2015; Liao et al, 2017). Maintenance planning can be done based on the data from the operators in the field submitted through work order to the maintenance department for proper action so that it will not harm the company (San et al., 2017).

2.3. Basic structure of genetic algorithm
The success of using genetic algorithms is largely determined by the determination of problem statements into the form of search points called chromosomes, as well as the selection of operators used. With the availability of these methods, the use of genetic algorithms selects only the op-ed operator which will be used. Nevertheless it does not demand the possibility of developing a new method for these genetic operators. An explanation of the various genetic operators that can be used will be presented in a separate section. (Elhadidy et al, 2014)

2.4. Genetic Algorithm
The Genetic Algorithm is a search method based on a natural evolutionary process (Sharma et al., 2013; Zukhri, 2014; Rivera et al., 2015), ie the formation of a random initial population consisting of individuals with properties dependent on the genes in their chromosomes.

2.5 Mapping From Natural Processes to Computing Processes
As already explained, According to Almeida et al., (2015) Genetic algorithms are a search technique adopted from the process of natural evolution. The computation process that occurs in this algorithm is analogous to the process of selection of living things in a population. Therefore, the search process in the Genetic Algorithm is done at once for a number of possible problem solving. Initial populations in genetic algorithms are formed randomly, while the next population is formed by genetic algorithm operators for generations. The next generation is formed by a series of processes similar to natural processes. Some of the following generations are formed from surviving chromosomes from previous generations, and some are chromosomes that were born from previous generations of chromosomes. (Martins et al., 2014; Tao et al., 2014; Momeni et al., 2014)
2.6 Chromosome
According to (Adhikary, 2015) in GA, chromosomes are an important part of the algorithm. One chromosome or individual represents one solution vector. Sometimes we can directly use this solution vector in GA implementation. Or sometimes encoding or decoding can also be done. The coding is done to represent a solution vector by using a binary number. It depends on the optimization problem encountered. Binary numbers, cross-breeding steps or mutations will be varied, conversely can also be done without encoding through the process of encoding. So the solution is in the form of continuous and selection processes, crosslinking and mutation is done by using a continuous number. At the end of the GA algorithm, if the coding is done, the process returns to its original origin value, often called decoding. In GA the population will be generated as a collection of chromosomes, where each chromosome represents a single solution vector. With the rise of this population, there will be many solutions available. (Samuel and Rajan, 2015)

3. Result and Discussion
3.1. Fitness value test from population
The Fitness Value Test is performed to measure the level of merit or suitability of the solution with the solution sought. This fitness calculation is done using Matlab software with the following results:

```matlab
>> MaxF
MaxF =
  0.7068

>> idk
Idk =
  11

>> MinF
MinF =
  0.0090

BestX =
  0.4148  106.5258
```

3.2. Crossover
Crossover is done to determine the parent and produce the offspring of crossbreeding. To cross-breed (Crossover) is using Matlab software with the following results:

```matlab
>> Father (x1)
Father (x1) =
  15

>> Mother (x2)
Mother (x2) =
  11

>> Son (x1,x2)
Son (x1,x2) =
  1.9570   78.0814
  68.3292   45.2132
```

3.3. Mutation
Mutations are made for the selection of populations or individuals with mutations. To do this mutation using Matlab software with the following results:
The results and discussion are as follows:

By using Genetic Algorithm method to determine the optimal machine maintenance system schedule then in the can results for Hell Nailing machine with type 0018 for the first period of January 2016 to April 2016 is 22,2213 equal to the 22nd day, month January, the 22nd, Friday, 9th hour 13th, doing maintenance machine with 30 minutes downtime. Then for the second period of May 2016 to August 2016 is 199.22236 is the same as the 199th day, July 17th, Monday, 9th, 18th, 18th, car maintenance with 30min downtime. Then for the third period of September of 2016 to December 2016 is 267,7643 equals the day to 267, October 13 th Thursday, at 7 min 04 doing engine maintenance with 30 minutes downtime. And for Heel Nailing machine with type 0019 for the first period ie january year 2016 until April 2016 is 17,0154 equal to day 17, january, date 17, monday, at 6, minute 06 doing maintenance machine with downtime 30 minute. Then for the second period of May 2016 to August 2016 is 173,6501 equals the 173th day, the month of july on the 11th of the day at 2 minutes 11 doing machine maintenance with 30 minutes downtime. Then for the third period of September to 2016 to December 2016 is 350.1750. Same with 350th day, December 16th day of the day "at, at 2 minutes 09 doing maintenance machine with 30 minutes downtime.

4. Conclusion

Based on the results of the analysis it can be concluded that by using Genetic Algorithm method can determine the schedule of optimal Hell Nailing machine maintenance in PT. Karyamitra Budisentosa that is in 1 year done 3 times treatment.

5. References

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