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Investigating the Maintenance and Repair System of Antonov 74 Aircraft Using Topsis Technique (Case Study: Pars Airline Services Company)

Abbas Moazami and Ebrahim Mohammadi Pirlar
Department of Management, Faculty of Humanities,
Islamic Azad University, Firoozkouh Branch, Tehran, Iran

Abstract: Today, the developing countries for their industrial and economic development used management techniques of developed countries. The latest management techniques used in this context according to experts views is the philosophy of comprehensive Productive Maintenance (TPM). To achieve the goal there are various tools and techniques and overall equipment effectiveness index is one of them. Overall equipment effectiveness is a measuring comprehensive instrument of factory production equipment which uses indicators (access ratio, performance ratio and quality ratio) reduction of machinery production and implementation of continuous improvement of production used. In addition, in the best corrective measures limit the devices that have a negative impact on production used. At the end uses and corrective measures will be extended to other parts of the plant. In this study, using a real experience of implementing comprehensive maintenance efficiency, its impact on improving productivity indicators such as the access ratio and efficiency ratio and quality ratio of equipment and overall effectiveness of equipment in Sodium Carbonate company evaluated.

Key words: Maintenance of TPM, effectiveness of OEE equipment, productivity, plant, Iran

INTRODUCTION

Accelerating progress of technology and the tremendous range of motion in the world of manufacturing, services and industry has increased so that countries cannot unaffected by industrial units and establishment of maintenance systems in order to achieve increased productivity, enhance product quality, enhance competitiveness and towards other goals. In today's world, economic and productive activities are much more dependent on machinery. The complexity of the equipment requires a scientific dealing or modern approach to use and maintain them and other traditional attitude is not responsive. Therefore, one of the most essential systems there is a documented system in each factory, scientific and practical maintenance and repair. Repeated defects in aircraft maintenance planning issues such as industrial maintenance are important elements in the system. An important issue in the present conditions in the global high-tech industry and in Iran industry is largely is lack of efficient and repeated failures control system for planning and control of airlines maintenance fundamental activities. This requirement arose from the expansion of the volume, variety and complexity of the mechanisms of machines, increase the amount and speed of production and from the perspective of product quality to meet customer needs, delivery date, price and ability to maintain and develop the industry in a competitive economy prevailing in the country. Moreover, it is at the global level in the airline industry.

In fact, the main task of maintenance management system based on prevention of repetitive defects, providing a means to manage and improve maintenance actions on equipment, plant and machinery of an organization. However, according to statistics in the air maintenance system continued process of some of the repetitive errors is not achieving the desired objectives and creates stagnation system. In recent years with the increase in cases of repeated objections, fix a case study the root causes of failure as one of the priorities of organizations. Since, the economic sanctions, particularly in the field of aviation is important to maintain capital, on the other hand sensitivities airline system requires the establishment of an immune system, creating a maintenance management system with emphasis on the need to address root causes of the repeated defects is very obvious. It can be failures with regard to their effect on safety, operation, efficiency and costs, categorized. TOPSIS a tool that can be used with the history of the equipment, period, effects and causes of the problems found. The frequency of errors codes in the computer makes possible a wide screen. Most advanced systems-computerized maintenance management system in industry benefit from this analysis. Charts help you

Corresponding Author: Abbas Moazami Department of Management, Faculty of Humanities, Islamic Azad University, Firoozkouh Branch, Tehran, Iran

identify the root causes of the TOPSIS is down. Computerized maintenance management system fault codes and the reasons for failure must relate to activities proposed reforms. According to the information provided, predictive maintenance can have multiple actions and preventive to avoid failures chose.

Research purpose:

- Create and maintain a maintenance management system with emphasis on the elimination of repeated errors radical for use in the analysis of the conditions and performance of aircraft maintenance
- Control maintenance costs due to repeated defects
- Improve preventive maintenance planning and scheduling net implementation activities
- Keep records of maintenance performed on aircraft performance and operations of the organization
- The ability to better access to spare parts and optimization of parts inventory planning and control, instrument and materials
- Create the perfect backdrop to raise the level of equipment reliability and safe flights of the civil airline system
- Control of foreign contractors in the country, especially Ukraine and Russia as the manufacturer Antonov 74 aircraft
- Increasing the efficiency of human resources, technical and flying in the studied company
- Control process maintenance work orders in the field of organizational structure
- Review and analysis of repeated failures and provide appropriate management model

Research hypotheses: According to the findings, optimize maintenance management increases reliability system and lower as a result of repeated errors.

MATERIALS AND METHODS

- Location: study repeated errors in the Antonov 74 aircraft engines in Pars Airline Services Company
- Time: limit errors occurred in the period of 5 years from the beginning of 2006-2011
- Sampling: sampling among eight aircraft and two engines, each of which contains errors and a selective basis is important
- Data collection tool: using files and logs and command and control tasks in the documents of the company
- Analysis method: using genetic algorithms and Excel software
- Limitations: this study estimated the probability of error by taking some time to consider maintenance as well as discuss some limitations of sanctions and other repair parts

Table 1: Genetic algorithm methodology and its tools control charts and excel

Objection 1	Objection 2	Objection 3	Objection 4	Objection 5
27/2/85	5/3/85	10/2/85	15/5/85	10/7/85
18/3/85	19/7/85	12/11/85	5/8/86	26/12/85
14/7/85	1/10/85	29/7/86	14/12/86	19/4/86
15/12/85	24/6/86	8/10/86	12/11/87	29/5/86
20/1/86	30/10/86	4/5/87	10/2/88	23/8/86
12/7/86	3/4/87	8/8/87	27/5/88	3/9/87
4/8/86	20/8/87	12/5/88	4/11/88	23/10/88
11/12/86	6/9/87	23/5/88	19/2/89	14/4/89
7/2/87	28/2/88	14/9/88	1/3/89	27/8/90
4/8/87	26/6/88	7/1/89	4/4/90	29/11/90
5/10/87	27/1/89	7/6/89		
10/12/87	14/8/89	17/3/90		
11/3/88	2/5/90	12/9/90		
4/11/88	22/12/90			
8/7/89				
2/10/90				

Instruments: From 01/01/2006-29/12/2011 repetitive defects list and the Antonov 74 airline engine systems with >10 times, leading to engine failure has been repaired and send it to (Table 1).

Objection 1: Failure of the O-rings oil system and generator output voltage.

Objection 2: Limit leakage out of the gearbox with 8 drops per minute rate.

Objection 3: The closure system is higher than normal engine revers.

Objection 4: Rpm engine speed when the engine is <12 sec to zero.

Objection 5: Promoting Tratel to 95% of the search engine was developed.

Sampling and data collection: Information on recurring defects 16 engine aircraft belonging to eight during 6 years with the use of records and logs and command and control tasks in the documents of the company was analyzed.

Optimization: After optimization, the 100 generation of the graph was drawn.

RESULTS AND DISCUSSION

Topsis techniques: Wong and ions, the first time introduced TOPSIS technique (Topsis) or prioritized based on similarity to ideal solution in 1981 such as AHP is a method of multi-criteria decision. This technique can be used to rank and compare different options and choose the best option and determine the spacing options (Chen *et al*., 2003). The advantages of this approach are

Table 2: Ranking the options are based on 5 expert

		Ranked according to it (expert)				
Abbreviation	Options	1	2	3	4	5
A	O-ring failures oil system and generator output voltage drop	4	2	5	3	5
B	Limit leak out of the gearbox with 8 drops per minute	3	4	4	4	4
C	Motor Riverse higher than normal closing	5	5	2	5	2
D	RPM engine speed when the engine is <12 sec to zero	2	3	3	2	1
E	Teratel increase to 95% with search engine	1	1	1	1	3

the criteria or indicators can be used to compare different units of measure and nature has both positive and negative. Other phrases can be both positive and negative indicators in the form of a combination of the techniques used (Momeni, 2006).

According to this method, the best option or solution is the closest solution-to-solution or ideal option and farthest from non-ideal solutions. The ideal solution, the solution is the most profitable and has the lowest cost while non-ideal solution, a solution that the highest costs and have the least profit. In short, the ideal solution of the maximum values for each criterion is achieved while non-ideal solution of the lowest amounts of each criterion is obtained. Following the close of each option based on the distance from the ideal ratio of positive and negative ideal is calculated the options are ranked based on the proximity coefficients in descending order.

The theoretical underpinning of TOPSIS method in studies such as Simonovic and Verma (2008), Tsou (2008) and Asgharpoour (1998) is presented.

Topsis process includes the following steps:

- Step 1: create a matrix for ranking decisions, it contains m and n standard option
- Step 2: the decision matrix is normal
- Step 3: matrix weighted scale
- Step 4: determine the ideal solution both positive and negative ideal solution
- Step 5: to obtain the distance to the ideals of positive and negative options
- Step 6: near the coefficient for each option
- Step 7: rollover option based on the proximity factor

Summary results topsis: Ranking TOPSIS according to five experts showed so obtained five different ratings that are summarized in Table 2.

Integration of different ratings by breda method: This method is based on majority rule (Momeni, 2007). In other words, this method of prioritizing the different options that are preferable to other options will have more priority and so on options that according to expert has five have less than other options, it will receive a lower priority. According to Table 3 options are mutually

Table 3: Breda method to integrate different priorities

To finalize the priorities based on priorities	Total preferences	E	D	C	B	A
4	1	X	X	M	X	-
3	2	X	X	M	-	M
5	0	X	-	X	X	C
2	3	X	-	M	M	M
1	4	-	M	M	M	M

Table 4: Ranking the options

Abbreviation	Options	The final rating based on Breda
E	Teratel increase to 95 percent with search engine	1
D	RPM engine speed when the engine is <12 sec to zero	2
B	Limit leak out of the gearbox with 8 drops per minute	3
A	O-ring failures oil system and generator output voltage drop	4
C	Motor Riverse higher than normal closing	5

compared with the second if the first option is preferred (i.e., row of the column). The mark «M» and if in the pairwise comparisons, there was no majority or the votes were equal, it «X» is encoded. The symbol «M» as it is preferred column, row upon row X point to the column is preferred, and so any comparison test individually is examined (Tavari *et al*., 2008).

As the results show the techniques Breda integration option E than other options in terms of the five qualified higher priority, so in the first place. Option D with a lower priority in the second and so on option B, A and C are respectively the third and fifth. Final ranking in Table 4.

CONCLUSION

The most important variables in the repair and maintenance system are time interval between scrutinies. These intervals may be used in place changed. The maintenance system on the aircraft is studied and fine-tune the intervals and little change these intervals can be optimized. The most important question is how repetitive errors with these inspections are limited relationship and these errors occur in the time interval of the inspections. Perhaps pattern where the inspections are however accurate but these intervals are designed to optimize aircraft based on initial conditions are not appropriate and responsive and it is less conducive to find bugs. Repairs needed on the effectiveness of the aircraft and its life and replacement of worn parts is due to various issues in each country is different and it may lead to need restrictions on access to parts increased more inspections.

The results of this study show that the relationship between the occurrence of errors are repeated from the time of inspection and the number of errors are not repeated in a linear pattern and so cannot be determined and reduction of inspections that are less than the annual variation in the error did not created. Although, this is a basic model and the other factors referred to in paragraphs next to them is not considered and it concluded that the inspection system alone in the prevention of these defects which can lead to a risk of collapse is not responding. The aircraft maintenance without changing the basic components involved in the repeated errors is not enough. In this study, the repeated errors associated with the 300 h inspections were studied. These defects are discovered repetitive inspections 30 h. These cases are successful. The 300 h inspections of the errors that have not discovered or after and in between the gaps have studied and at least it was examined. The results showed that the 300 h inspections are these imperfections of future expected increases their number will be increased year. Therefore, there is a logical relationship between these two variables.

In this study, only 8 aircraft were studied. The data were analyzed 6 years. The amount of information and very little volume to determine the optimization objective function are limited. It seems that due to poor optimization and lack of linear correlation with the pattern of these limitations is optimized final. Exact details are not available all the inspections. The results of this study and taking into account all the constraints is that the final recommendation in addition to the inspection intervals optimize their essential parts replacement. Additional factors that may be involved in optimizing among them pointed to other aircraft inspection and determination. Based on this study, in the current situation is less important as long distance inspections but there is optimum value and repetitive errors chance is less.

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