

Selection of maintenance strategy using AHP, ANP and TOPSIS techniques for Coveris Advanced Coatings (MRes Engineering)

Lukman Belo-Osagie¹, supervised by Prof Alison McMillan¹ and managed by Dr Keith Vidamour²

¹Glyndwr University, Plas Coch Campus, Mold Road, Wrexham LL11 2AW

²Coveris Advanced Coatings, Wrexham Industrial Estate, Wrexham LL13 9UF

Introduction

This project was carried out with in collaboration with Coveris Advanced Coatings, Wrexham.

Over the years, they has been a massive dependency on machines in our day-to-day activities in homes, offices, hospitals and industries. These machines make life easy in general. The most significant advantage of machines is in production, based on the ever increasing demand for goods. For this reason, maintenance of these machines is very important. The consequences of failure in a machine include loss of production, safety/health hazards and lost time. Having the right maintenance strategy plays a vital role in attaining organizational goals and aims, by reducing the machine downtime, improving production quality and increasing production, K.Shyjith et al (2008).



Methods

Three multi-criteria decision techniques are used in selecting the most appropriate maintenance strategy for Coveris (coating industry). The wide web stripper machine (WWS) is used as the pilot example for the following decision techniques:

- Analytical Hierarchy Process (AHP)
- Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
- Analytical Network Process (ANP)

In the case of AHP and TOPSIS, the algorithms were implemented in MSExcel. In the case of ANP, a package, "Super Decision Software", was employed.

Procedures

It is necessary to categorize the maintenance aspects of the WWS into different risk levels of low, medium, high and very high risk levels. A risk and consequence matrix was employed.

The alternative maintenance strategies used in this experiment were: **Corrective**, **Preventive**, **Predictive**, **Condition based** and **Reliability centered** maintenance.

Each industry type would have different criteria and sub-criteria when choosing their most appropriate maintenance strategy. For this case, the criteria and sub-criteria were:

- Added value – On time delivery, profit, quality and image
- Cost – Hardware, software, training and spare part inventory
- Safety – Personnel, external and internal environment
- Implementation – Workers, management decision and technology



Figure 1. Wide Web Stripper

Data analysis

Data used in this experiment were acquired from objective and subjective views, gathered from plant maintenance records and employee surveys. It is necessary to always check for the potential inconsistency of judgment using consistency ratio formula

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad CR = \frac{CI}{RI}$$

Where CI is known as consistency ratio, RI is ratio index and CR is consistency ratio index.

Results

Application of AHP reveals a significant difference between **Condition based** and **Predictive** maintenance, as shown in Figure 2, however there was no such significant difference when the TOPSIS technique was applied.

When the technique ANP was employed, **Reliability centered** maintenance was ranked first, but the difference between it and **Condition based** was not significant.

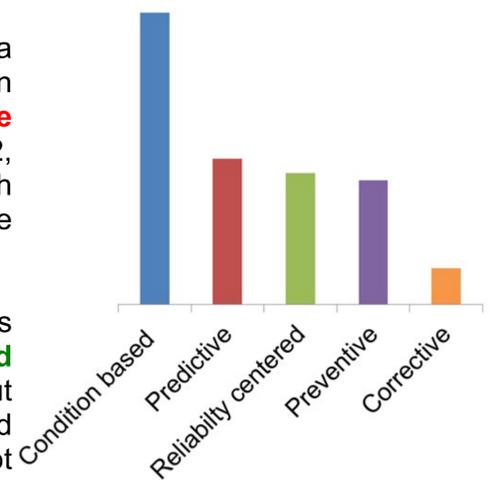


Figure 2. AHP Ranking

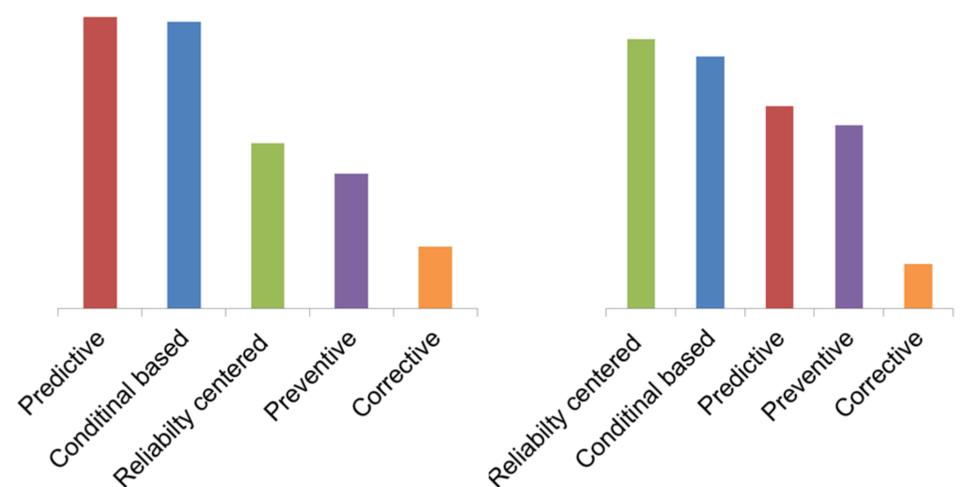


Figure 3. TOPSIS Ranking

Figure 4. ANP Ranking

Conclusions

The above results indicate that **Condition based** maintenance is the most appropriate maintenance strategy for the WWS machine, however, based on the implementation and servicing costs of condition monitoring devices such as vibration and thermal analysis, it would not be economical for Coveris to use it.

ANP is known as a technique that can gives more informed results since it enables more comparisons than either AHP and TOPSIS. The result for ANP would be the most preferred maintenance strategy **Reliability centered** maintenance is a combination of all other maintenance strategy.

References

- [1] K Shyjith, M Ilankumar and S Kumamanan, "Multi-criteria decision making approach to evaluate optimum maintenance strategy in textile industry", Journal of Quality in Maintenance Engineering. Vol. 14, 2008, pp. 375-386.
[2] T Saaty, Super Decisions Software, www.superdecisions.com [last accessed 19th October 2014]