Objectives: Our work provides an analysis of the contribution of multi-criteria decision analysis (MCDA) methods in the case of industrial maintenance policies selection. The purpose of this research is mainly given for establishing a full inventory of main decision criteria which may be considered for assessing maintenance strategies and policies. It concludes with an application of two different MCDA methods for selecting the suitable maintenance policy for the hydraulic couplings installed in a mining phosphates plant.

I. Formalizing the various maintenance policies

Main classes of maintenance policies:
- Corrective maintenance (CM)
- Preventive maintenance (PM)
- Opportunistic maintenance (OM)
- Condition-based maintenance (CBM)
- Predictive maintenance (PRM)

Subclasses of policies:
- Run to failure maintenance policy
- Breakdown maintenance policy
- Routine Maintenance policy
- Scheduled Maintenance policy
- Age replacement policy
- Block replacement policy
- Failure limit policy
- Sequential preventive maintenance
- Repair cost limit policy
- Repair time limit policy
- Group maintenance policy

II. Decision criteria

The most meaningful decision criteria are determined in number of 70 which are grouped into eight main categories.

III. Maintenance policies selection model using MCDA methods

III.1. first result with AHP method

AHP hierarchy scheme with final score:

1. Goal:

2. Criteria:

   - Safety (29%)
   - Maintenance cost (34%)
   - Applicability (71%)

3. Final score:

   - Corrective maintenance CM (39.7%)
   - Preventive Maintenance PM (25.1%)
   - Condition-Based Maintenance CBC (15.4%)
   - Predictive Maintenance PRM (14.3%)

IV. Case study

In this case we consider one repetitive equipment (hydraulic couplings) in mining company which are often used on the driving engine head of conveyors for transporting ore. The different alternatives of maintenance policies envisaged by the maintenance department are: corrective-CM, preventive (scheduled)-PM, condition based maintenance using thermography technics-CBM and predictive-PRM. The decision criteria selected for assessing those alternatives are eight criteria: two criteria ($C_4$ and $C_5$) related to the maintenance costs, three related to the safety ($C_1$, $C_2$, and $C_3$) and last three ($C_6$, $C_7$ and $C_8$) related to the applicability of the policy.

IV.2. Second application with ELECTRE II method

Table 2. Performance matrix of the MCDA problem

In the mindset of ELECTRE methods for defining the outranking relation, the index values of consonance and discordance are compared to the predefined thresholds values. The ELECTRE II method uses two outranking relations (Strong $S^+$, and Weak $S^-$) for alternatives assessment.

V. Conclusion

The results obtained by the two different MCDA methods are the same. This application is a proof that the method of multi-criteria decision support can contribute to the choice of maintenance policy in the case of one repetitive machine (or element of). We underline also that the framework of decision criteria established above should strongly facilitate the process of decision making for maintenance policies selection. The future work will be focused to develop this framework of decision criteria and to determine their consistencies in different type of industrial fields.