A decision making model for maintenance strategy: A combined approach analytic hierarchy process (AHP) and fuzzy logic

A decision making model for maintenance strategy: A combined approach analytic hierarchy process (AHP) and fuzzy logic

Mohammad Moghaddaszadeh Kermani , Dr. Moray W. Kidd

The University of Manchester

School of Mechanical, Aerospace and Civil Engineering
Management of Projects Research Centre

Introduction

The poster aims to compare two tools for decision makers that intend to support decision for the selection of most appropriate maintenance strategy in oil and gas plants. The analytic hierarchy process (AHP) decision making model proposed based on case study that investigate implementation of an integrated condition based maintenance strategy for a plant in oil and gas industry. Moreover fuzzy set theory employed for reducing the vagueness associated with manager preferences elicited via pairwise comparisons.

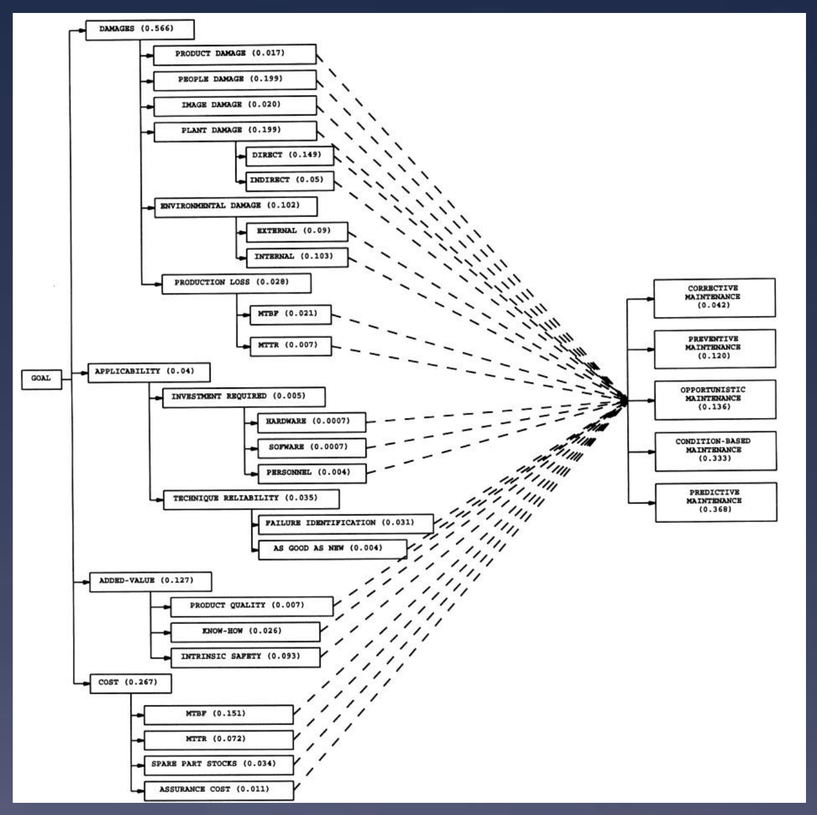
The oilfield developed by British Petroleum(BP) and was brought on stream in June 1990 with the production of 95000 barrels of stabilised crude oil. 670 tonnes of LPG and 16 million standard cubic feet of sales gas in which the associate gas is then fractionated, the methane and ethane are exported as sales gas directly into the grid, while the propane and butane are liquefied and transported by rail tanker. Since operations began, the traditional cost benefit analysis were considered to evaluate the appropriateness of condition based monitoring strategy for rotating equipments.

Existing theories and Gaps in Research

1-The original method for the selection of maintenance strategies for Italian oil refinery was given by (Bevilacqua and Braglia, 2000). but a crisp decision-making method as the traditional AHP is not appropriate because many of the maintenance goals taken as criteria are non-monetary and difficult to be quantified.

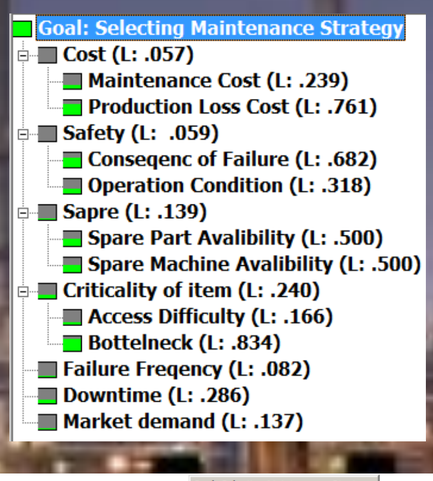
2-Al-Najjar and Alsyouf(2003), Sharma et al. (2005) assessed the most popular maintenance strategies using the fuzzy inference theory and fuzzy multiple criteria decision-making (MCDM) evaluation methodology. The application of the fuzzy theory for this problem is a good solution. However, only a few failure causes were considered as the criteria in their Studies.

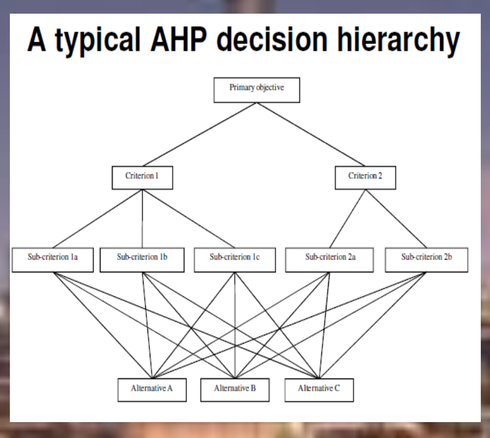
3- Mechefske and Wang (2003), proposed fuzzy methodology to evaluate and select the optimum maintenance strategy and condition monitoring technique which is based on qualitative verbal assessment inputs is more practical than the formers, because many of the overall maintenance objectives of the organization are intangible. However, the method of Mechefske and Wang (2003) is very subjective to directly assess the importance of each maintenance goal and the capability of each strategy to achieve each maintenance goal.

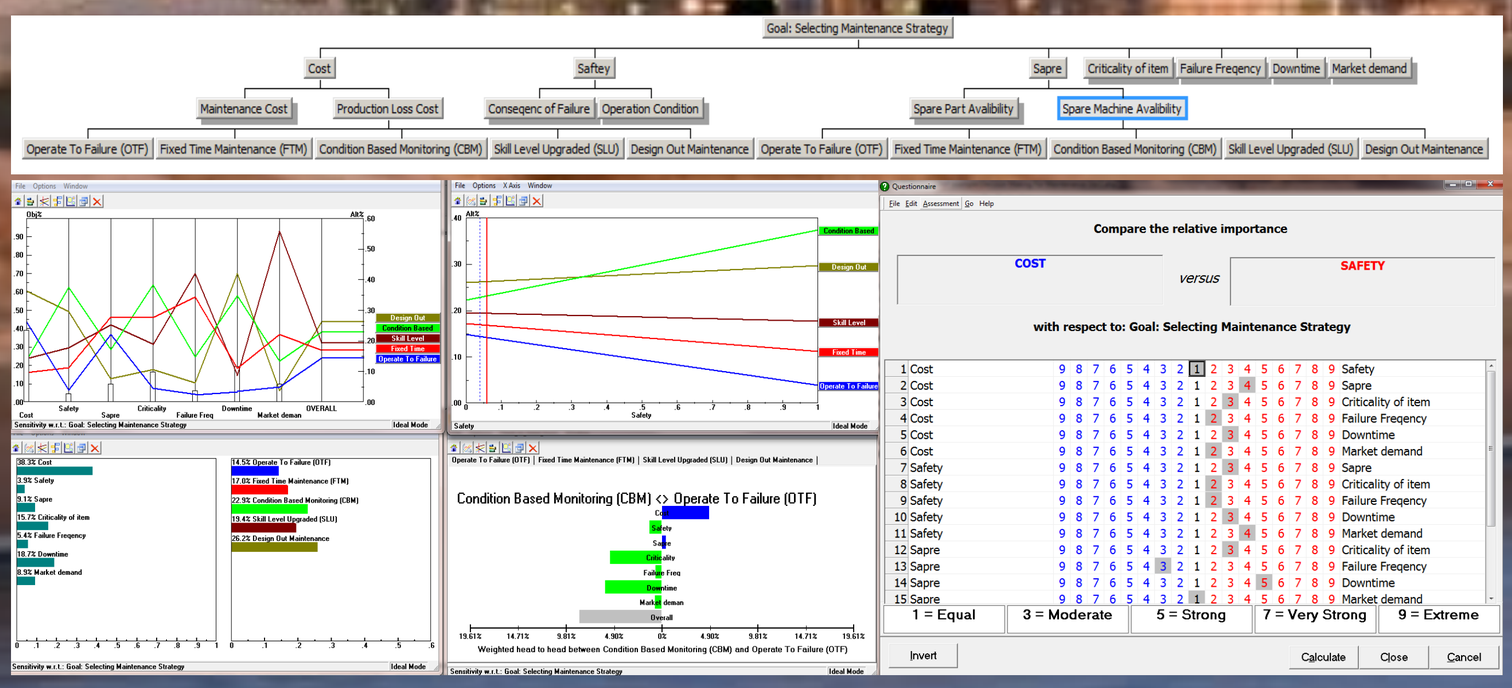


The Proposed AHP Model and Findings

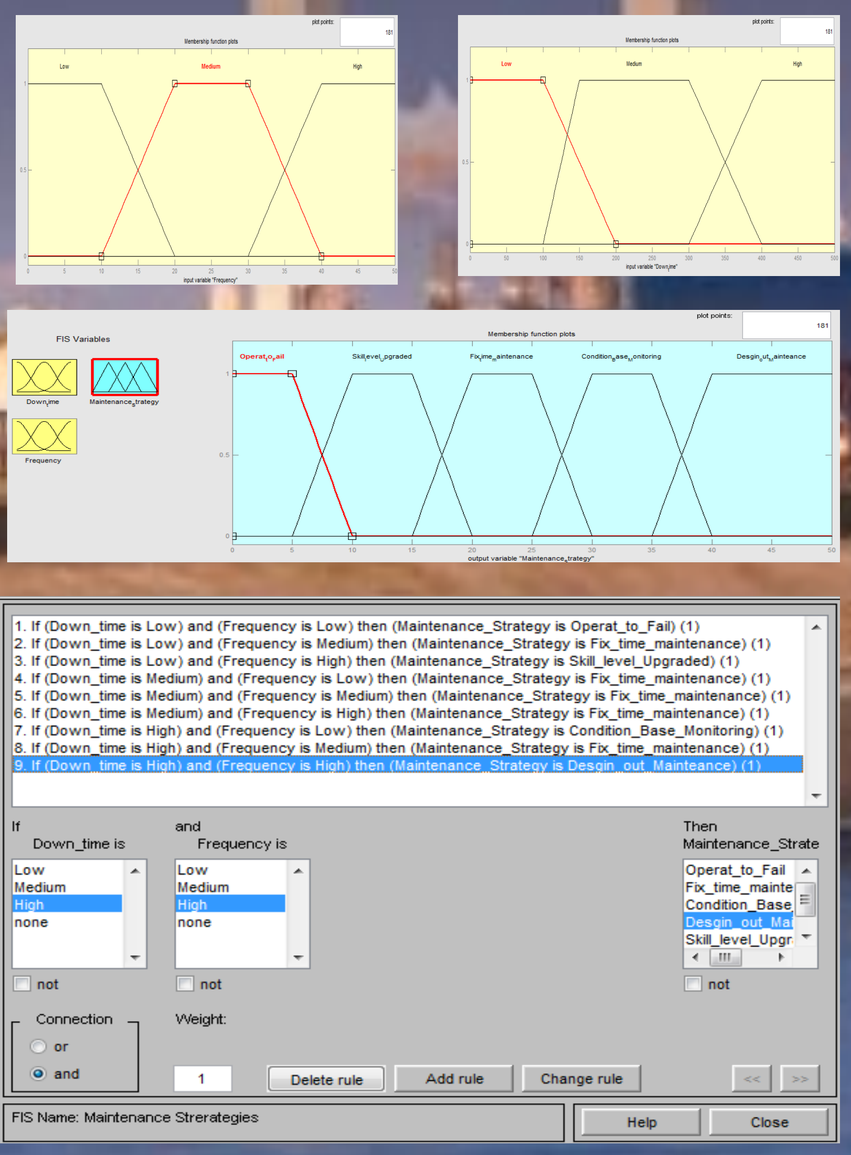
Considering the shortcomings of the existing methods above, it is necessary to develop a new evaluation scheme for maintenance strategies. This scheme should include different aspects of maintenance goals, be able to model uncertainty and imprecise judgments of decision makers (i.e. maintenance managers and engineers), and be easy to use.



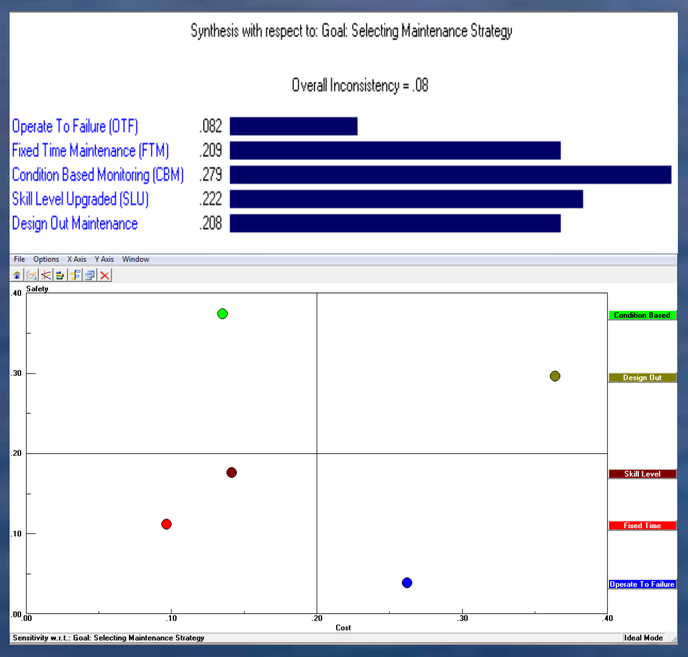


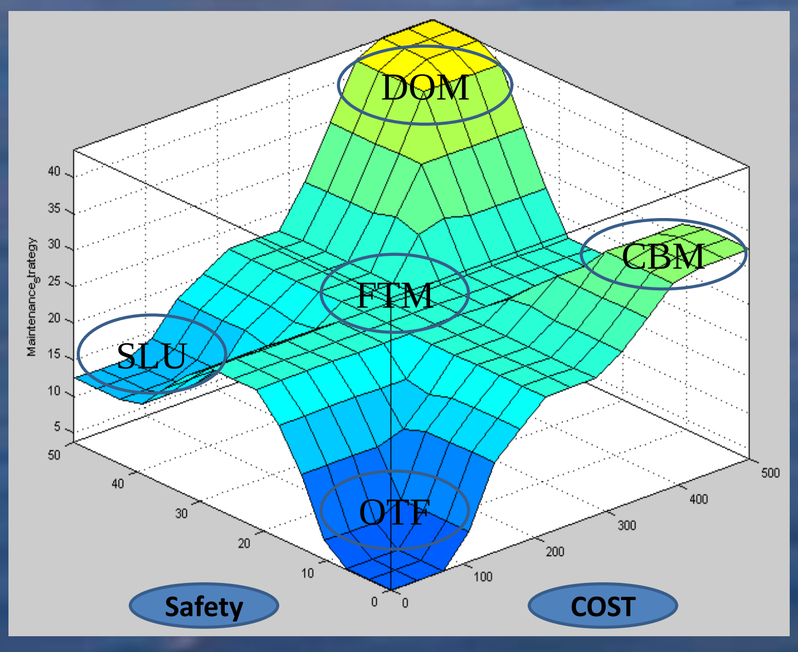


Implemented Fuzzy interface theory



Combined Fuzzy AHP Results





Conclusion

a) An optimal maintenance strategy obtained for the BP process plant which can effectively improve availability and reliability levels of plants equipment, and reduce unnecessary investment in condition maintenance techniques.

b) The fuzzy AHP models deal with the uncertainty related to imprecise judgments of decision makers and experts by quantifying the qualitative data obtained through AHP questioners to fuzzy interface model.

c) The results illustrated that CBM is not necessarily improves the safety of plant whereas investment in upgrading the skill of operators could effectively improves the level of safety in the process plant .

References

Updated from (W.Labib, 2004)

AL-NAJJAR, B. & ALSYOUF, I. 2003. Selecting the most efficient maintenance approach using fuzzy multiple criteria decision making. *International Journal of Production Economics,* 84**,** 85-100.

BEVILACQUA, M. & BRAGLIA, M. 2000. The analytic hierarchy process applied to maintenance strategy selection. *Reliability Engineering & System Safety,* 70**,** 71-83.

MECHEFSKE, C. K. & WANG, Z. 2003. Using fuzzy linguistics to select optimum maintenance and condition monitoring strategies. *Mechanical Systems and Signal Processing,* 17**,** 305-316.

SHARMA, R. K., KUMAR, D. & KUMAR, P. 2005. FLM to select suitable maintenance strategy in process industries using MISO model. *Journal of Quality in Maintenance Engineering,* 11**,** 359-374.

W.LABIB, A. 2004. A decision analysis model for maintenance policy selection using a CMMS. *Journal of Quality in Maintenance Engineering,* 10**,** 191-202.

Acknowledgements

The authors would like to thank the support from Dr.Moray Kidd which provided the training course in maintenance strategy where the data obtained for the BP process plant case study and also Risk , Reliability and Maintainability training course.

PGR Conference, 9 April, 2014 School of MACE C1 George Begg Building