Handling maintenance priorities using multi criteria decision making

Dag Eirik Nordgård, SINTEF Energy Research
Jørn Heggset, SINTEF Energy Research
Even Østgulen, BKK Production
NORWAY
Contents of the presentation

- Introduction / Background
- The challenge
  - The framework and the goal
- Analysing strategies
  - Qualitative criteria
  - Economic criteria
- Results / examples
- Conclusion
Introduction / background

- Substantial changes in the Norwegian power sector during the last decade
- Few new power plants being built
- Focus on operating and maintaining existing plants in an optimal manner
- When deciding what to do there are several criteria which need to be considered:
  - Economy
  - Safety
  - Environment
Holistic scheme for maintenance planning is the topic for a 5-year research project.

- Losses due to outages
- Income / cost due to rehabilitation
- Handling of qualitative criteria
- Evaluation of probability of failure
- Optimal timing of projects
- Project DB
The challenge

- The power companies face large portfolios of project proposals which the maintenance administration have to make priorities among
  - Limitations in funding, labour, time
- Projects proposals are launched due to many different reasons which are hard to compare
- The approach presented in the paper describes a decision support tool which aids the choosing between a variety of project proposals and selecting the projects being the best for the company’s strategies
Analysing strategies

The presented approach gives two evaluation processes for the projects proposals:

- Economic criteria
- Qualitative criteria

Diagram:
- Project
  - Qualitative criteria
  - Economic criteria
  - Aggregation of results
  - Decision
Handling qualitative criteria

- To aid the inclusion of qualitative criteria into the overall project evaluation MCDM-methods is being used
- In the projects activities the AHP-method *(Analytic Hierarchy Process)* has been used
- Stages in structuring the decision model:
  - Identification of which decision criteria to be included
  - Establishing the relative weights of the criteria using the AHP-method and pairwise comparison
  - Establishing scores and scales for each criterion
- Using the decision model:
  - Evaluation each project using the model
  - Obtaining a *Qualitative Utility Value (QUV)* for each project
Handling economic criteria

- The Net Present Value (NPV) is an important figure when comparing projects
- Economic analysis of maintenance projects is often treated a minimum cost approach.
- In the project activities another approach is chosen – namely to focus on the profitability of the projects
Handling economic criteria II

Cost elements included in the calculation of NPV:
- Resources (labour, parts, transport, etc)
- Unavailability costs during the project
- Maintenance introduced costs
- Other costs

“Income” elements included in the calculation of NPV:
- Increased power efficiency
- Increased availability (reduced failure probability)
- Deferment of future investments
- Other income
Results - Schematic view

Balancing QUV and NPV
Example – results from evaluation

- Net present value, [kNOK]
- Qualitative utility value

Efficient frontier

1 - Aggregate
2 - Hatch rehab.
3 - Water level meas.
4 - Turbine rehab.
5 - Dam rehab.
What can be gained?

- Qualitative criteria that have effect on the analysis of a project are given explicit attention
- Requires a clarification of which aspects to be taken into account
- Possible to make a perspicuous representation of both economic and qualitative aspects of the projects
- Results from projects evaluation are systematically documented
- More consistent projects evaluation in case of multiple caseworkers
Conclusions

- The paper presents a way of evaluating maintenance projects taking both economic and qualitative criteria into account.
- Qualitative criteria are being structured using the AHP-method which have shown to be an effective tool for this purpose.
- Using such an approach as outlined in the paper makes it easier to perform consistent evaluation of maintenance projects according to the company’s strategies.
- The MCDM-method does not make the decision, but it gives the decision maker a better basis for making the right choice.