HYPERWIND

FARM MAINTENANCE SCHEDULE OPTIMIZER

FMSO MODULE

CONTEXT

Renewable energy producers are facing today the decrease of their feed-in tariff while their LCoE (Levelized Cost of Energy) remains constant or even increase. For wind farms the operation and maintenance costs Is a large part (up to 40%)[1] of the LCoE. In this context, wind farm managers are strongly interested in optimizing their maintenance operations and minimizing their costs.

Operation and maintenance of wind farms require recurrent wind turbine visits in order to perform scheduled service operations, conduct inspections and repair different failures. Each of these operations has its constraints in terms of logistical means, technicians' capabilities and weather conditions. When they schedule all these operations, wind farm managers must also consider the availabilities of spare parts and technicians, the costs and availabilities of logistical means and the impact on operational availability. This is an important optimization challenge that today is solved "by hand" by a scheduler. But, even for medium size wind farms, this optimization problem is way too complex to be sure that the "handmade" schedule is close to the optimal solution which will ensure the lower final cost.

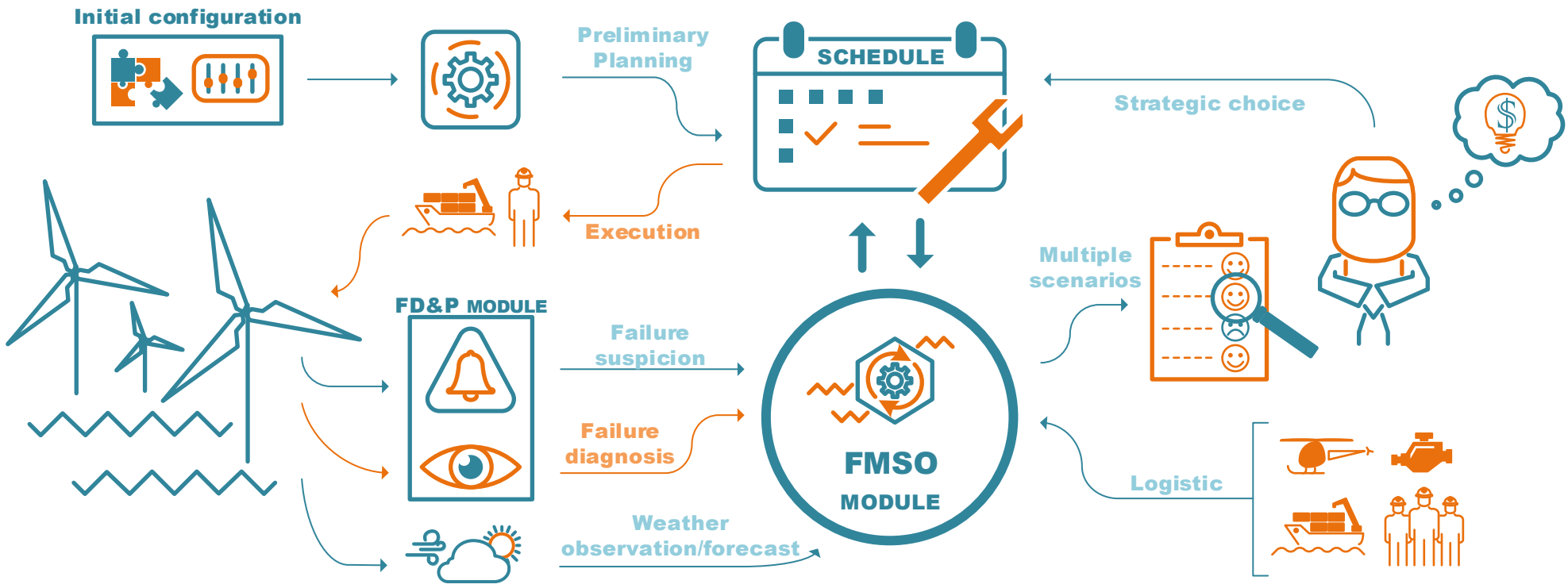
OBJECTIVE

Help wind farm managers to choose an optimal maintenance scheduling by suggesting them at each step the most promising solutions obtained through an automatic and comprehensive context analysis.

BENEFITS

- Enable a significant reduction of maintenance costs
- Simplify manager's work and offer support for informed choices
- Improve wind farm operational capacity

HOW IT WORKS



Criterias

- ✓ Minimize production loss
- ✓ Reduce maintenance costs
- ✓ Regroup tasks that require:
  - similar logistical means
  - the same preparation

Preliminary planning

Inputs

- ✓ Period size (ex: "1 week")
- ✓ Initial planning horizon (ex : "1 year")
- ✓ Expected maintenance teams availabilities

Steps

- ○ Schedule the contractual preventive tasks for the given time horizon by minimising the global cost
- ○ Repeatedly extend the schedule as times goes by

Initial configuration

Farm & wind turbines description

- ✓ Location & relative positions
- ✓ Wind turbine's power curves
- ✓ Wind turbine's states & previous maintenances

Maintenance tasks description

- ✓ Periodicity & duration
- ✓ Required logistical means (cost, delay)
- ✓ Required spare parts (cost, lead time)
- ✓ Required preliminary preparation (cost, duration)
- ✓ Acceptable weather conditions

Dynamic planning adjustment

Events occurences

- ✓ Failure suspicion – automatically generated by FDM (Failures Detection Module)
- ✓ Failures – observed by technicians

Weather observation and forecast

- ✓ Adjust schedule if current weather conditions do not allow the fullfillment of programmed tasks

Logistics

- ✓ Logistical means availabilities fluctuate
- ✓ Maintenance teams : real availability & skills variability
- ✓ Spare parts stock's fluctuations

Technicians feedback

- ✓ Task completion / interruption / difficulties
- ✓ Confirm/disprove failures occurences

For each new event occurrence the FMSO module:

- ✓ Analyse the current context on the appropriate temporal window (current planning, event caracteristics, …)
- ✓ Identify appropriate reactions : request inspections /confirmations ; planify corrective maintenace tasks
- ✓ Make a multicriteria quantification (effective maintenance costs; estimated production loss)
- ✓ Allow wind farm manager to make the best choice

[1] *Observatoire des coûts de l'éolien terrestre*, PÖYRY and FEE (Oct. 2016)

Version A

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