A structured approach for data collection and analysis

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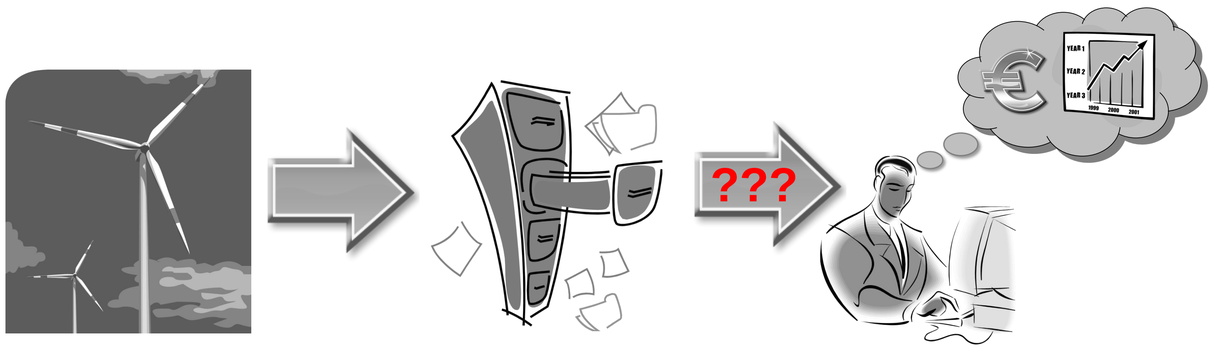
Introduction

There are many opportunities to lower the cost of offshore wind energy. One of them is to refine the manner in which operators collect, store, process and make O&M decisions from the vast quantities of operational data produced by the wind farms.

ECN is developing the Operation & Maintenance Cost Estimator (OMCE) that brings “order into chaos” and allows operators to make the best possible decisions in refining their O&M strategies. This poster presents the work completed in the Far Large Offshore Wind (FLOW) R&D program, together with project partner RWE.



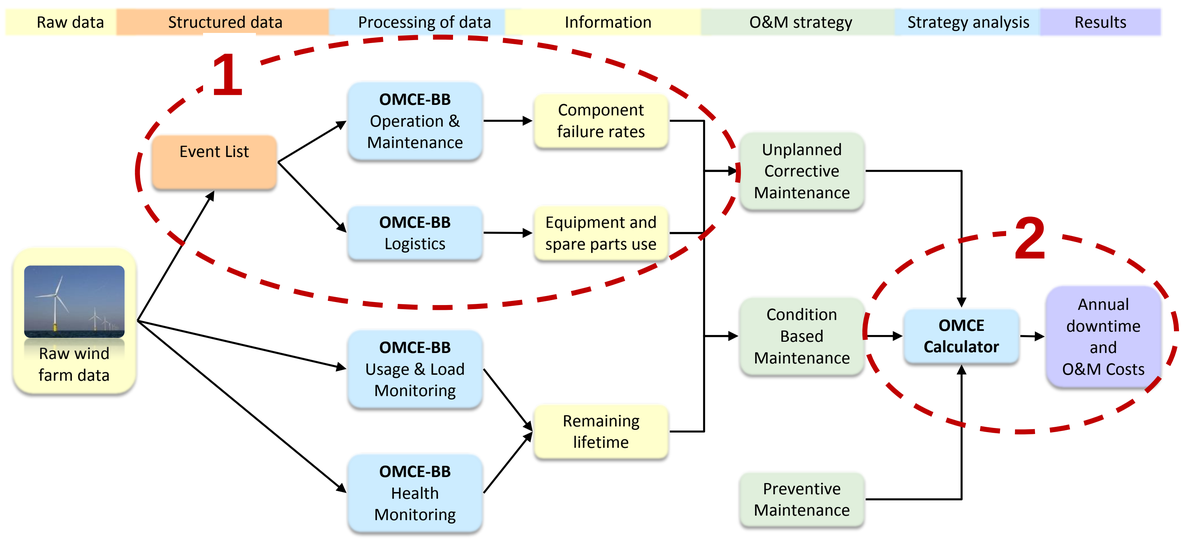
Objectives and method

<u>FLOW R&D project and objectives:</u>

- ECN and project partner RWE further develop and apply the OMCE approach within the Dutch FLOW R&D programme.
- The main objective is to demonstrate the OMCE in an operational offshore wind farm and assess the realised cost reductions.

<u>The OMCE method consists of two main analysis modules:</u>

1. The OMCE Building Blocks (BBs) to process and analyse (structured) data.
2. The OMCE-Calculator to assess future O&M effort by performing maintenance strategy analysis.



Operation & Maintenance Cost Estimator structure

This presentation addresses procedures to structure data collection and perform analysis with the OMCE Building Blocks as indicated in the structure above (1).

O&M data source examples

As input for OMCE development, O&M data covering a 3 month period was provided. Data sources supplied include:

- List of SCADA parameters
- Alarm list
- Meteorological and wave data
- Monthly downtime summary reports
- Daily work reports
- Turbine breakdown in RDS-PP coding
- Daily vessel reports

A detailed analysis revealed that O&M data is stored in different formats which makes them difficult to correlate.

Reason For Visit:		Downtime Cause.	# Downtime Period			
WTG	# Status	Description	Start	Finish	Total Downtime	WTG accessed today? (Y/N)
1	RUN				0.00	N
2	RUN				0.00	N
3	PAUSE	Service	09:37	16:45	7.13	Y
4	RUN				0.00	N
5	RUN				0.00	N
7	RUN				0.00	N
8	RUN				0.00	N
9	RUN				0.00	N

DAILY VESSEL REPORT

Wind Farm:				
	1st sailing	2nd sailing	3rd sailing	Tool Box Talk:
Port departure time:	07-40			
Arrival wind farm (1st drop off):	08-30			
Depart wind farm (last pickup):	14-10			
Port arrival time:	15-20			AIS recorded/backup (Y/N):
FUEL TAKEN (Y/N):	Y	FUEL CONSUMPTION: (litres):		
CONDITION OF TURBINE / Metmast / Access Landing / Ladders etc: state condition on arrival at WTG				
	WTG no:	COMMENTS:		PAX ID No's & TIME OF TRANSFER:
TURBINE	27			
Access landing	OK			
Ladders	OK			

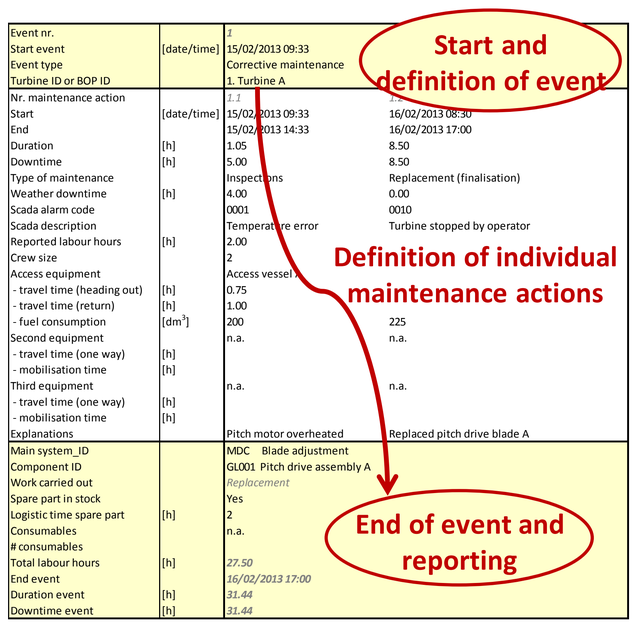
Examples of operational data stored in different uncorrelated formats

Event List format for structuring O&M data

To correlate O&M data from different sources the “Event List” format is defined as part of the OMCE:

- A maintenance event is considered as a (sequence of) maintenance action(s) to prevent or to correct turbine malfunctioning.
- Event data should be collected in chronological order.
- Fields specified match required input for O&M cost and strategy modelling.
- Manually filling the Event List with 3 months of RWE’s data results that more than 90% of required fields are available from existing sources.

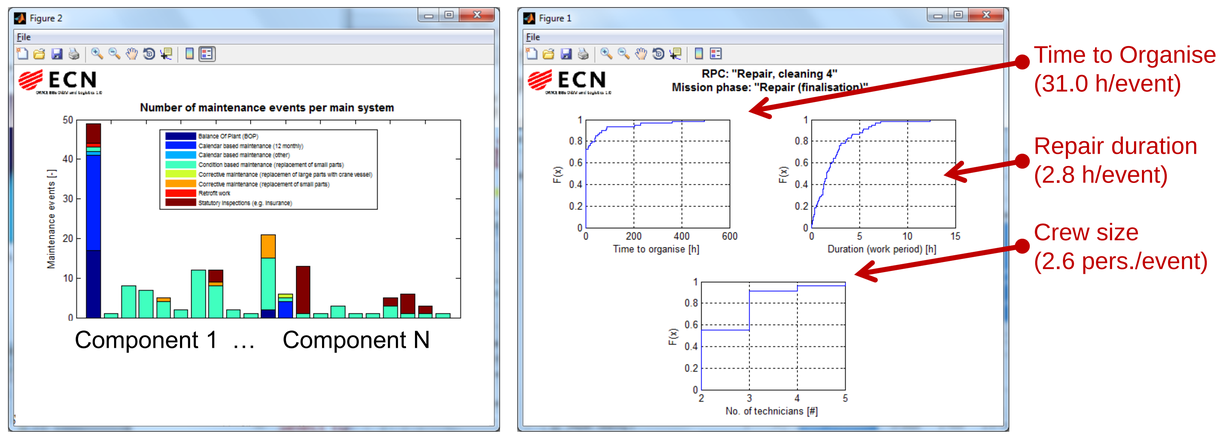
Event nr.		*1*	
Start event	[date/time]	15/02/2013 09:33	
Event type		Corrective maintenance	
Turbine ID or BOP ID		1. Turbine A	
Nr. maintenance action		*1.1*	*1.2*
Start	[date/time]	15/02/2013 09:33	16/02/2013 08:30
End		15/02/2013 14:33	16/02/2013 17:00
Duration	[h]	1.05	8.50
Downtime	[h]	5.00	8.50
Type of maintenance		Inspections	Replacement (finalisation)
Weather downtime	[h]	4.00	0.00
Scada alarm code		0001	0010
Scada description		Temperature error	Turbine stopped by operator
Reported labour hours	[h]	2.00	
Crew size		2	
Access equipment		Access vessel 7	
- travel time (heading out)	[h]	0.75	
- travel time (return)	[h]	1.00	
- fuel consumption	[dm^3]	200	225
Second equipment		n.a.	n.a.
- travel time (one way)	[h]		
- mobilisation time	[h]		
Third equipment		n.a.	n.a.
- travel time (one way)	[h]		
- mobilisation time	[h]		
Explanations		Pitch motor overheated	Replaced pitch drive blade A
Main system_ID		MDC Blade adjustment	
Component ID		GL001 Pitch drive assembly A	
Work carried out		*Replacement*	
Spare part in stock		Yes	
Logistic time spare part	[h]	2	
Consumables		n.a.	
# consumables			
Total labour hours	[h]	*27.50*	
End event		*16/02/2013 17:00*	
Duration event	[h]	*31.44*	
Downtime event	[h]	*31.44*	



Example of Event List specification

Data analysis with OMCE Building Blocks

In the FLOW OMCE project, BBs ‘O&M’ and ‘Logistics’ are further developed, verified and applied to analyse the failure behaviour of components and logistic aspects of repairs respectively. This is achieved using the manually processed O&M data in the Event List format as input.



Examples of Building Block analysis results: Overview of number/type of maintenance event per system (left) and repair classification (right)

Conclusions and next steps

To obtain useful information as input for O&M cost and downtime estimates it is essential that operators structure their data collection processes. Through the FLOW OMCE project the Event List specifications are refined and software tools for Building Blocks ‘O&M’ and ‘Logistics’ are developed and verified working. Additionally the OMCE-Calculator software is further developed to allow the modelling of advanced maintenance strategy scenarios.

Next steps achieved will be:

- Integration within operator Computerised Maintenance Management Systems (CMMS)
- Expanding the data analysis possibilities based upon user feedback
- Extending the track record of the OMCE by implementation in offshore wind farms

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