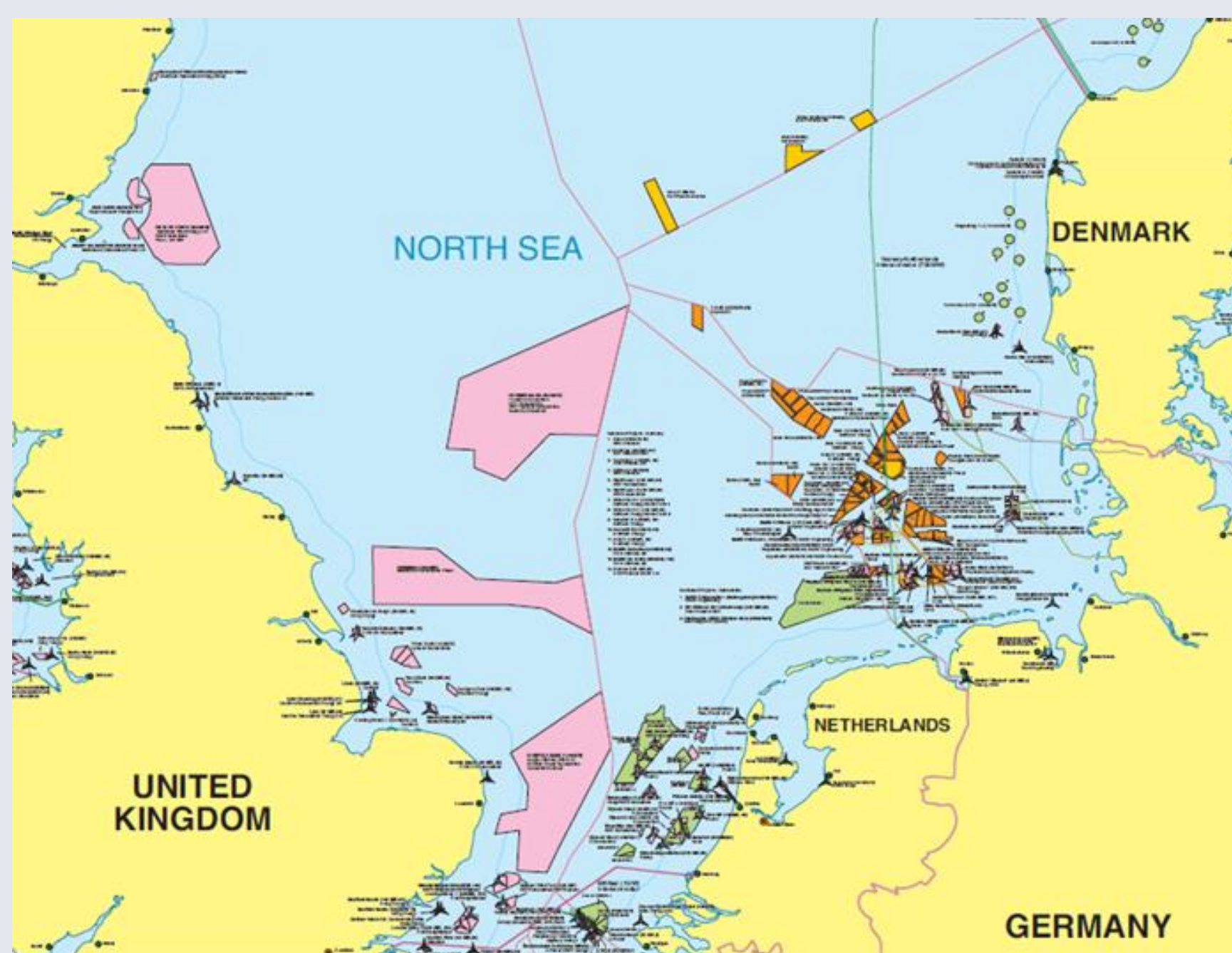




Operation & Maintenance far Offshore

- New wind farms are established further offshore and even far offshore (EWEA, 2013)
- Doubling of a turbine capacity from e.g. 4MW to 8 MW often result in an increase of absolute costs for components, but not in doubled costs
- Operations & Maintenance becomes much more challenging for 25 year of operation far offshore than near shore
- Narrow weather window at rough sea far from the coast makes Operation and Maintenance challenging

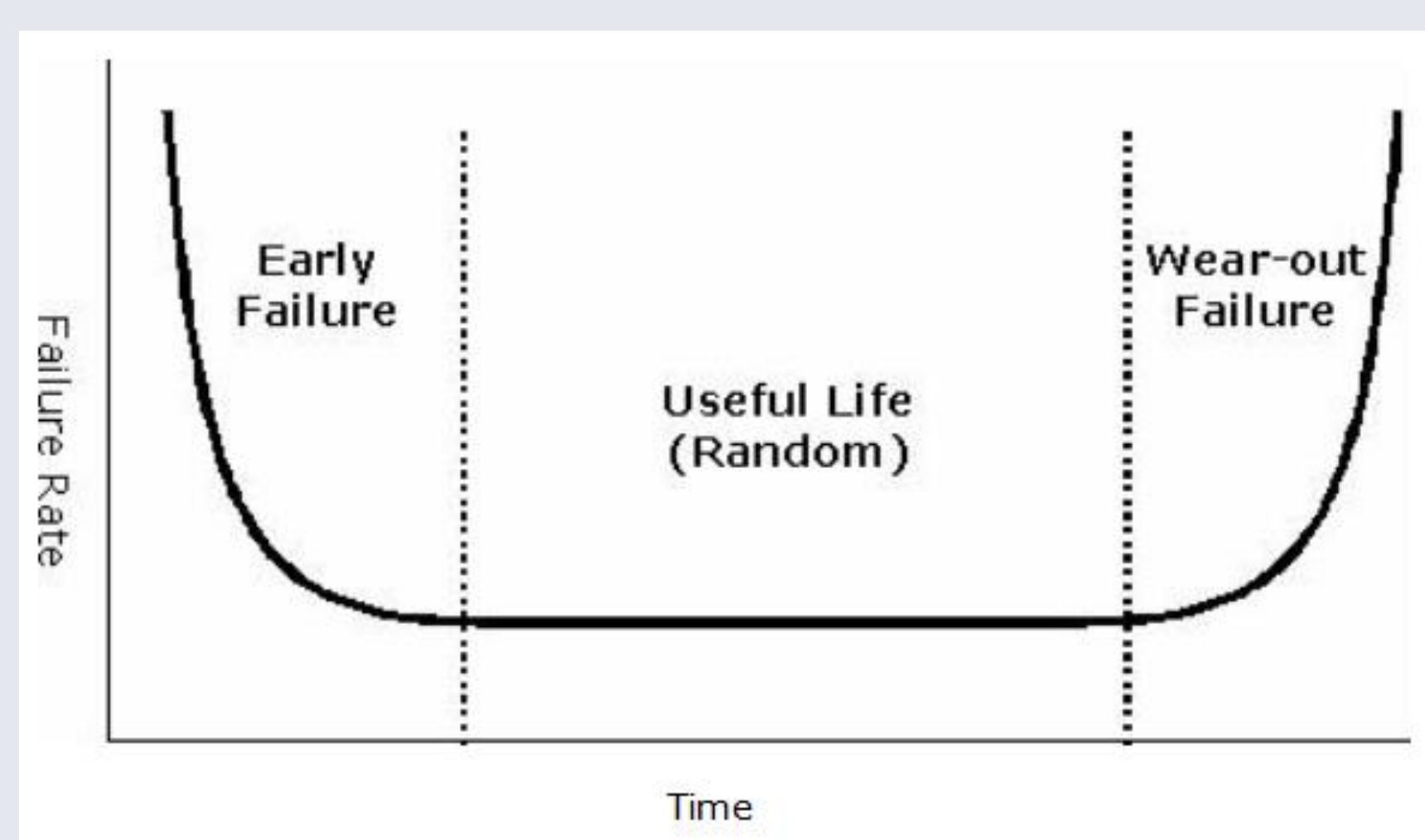


- Operations & Maintenance becomes much more challenging for 25 years of operation
- Narrow weather window for execution of maintenance call for a constant rescheduling and re-planning of tasks
- Reliability, availability and accessibility becomes key to Operation & Maintenance

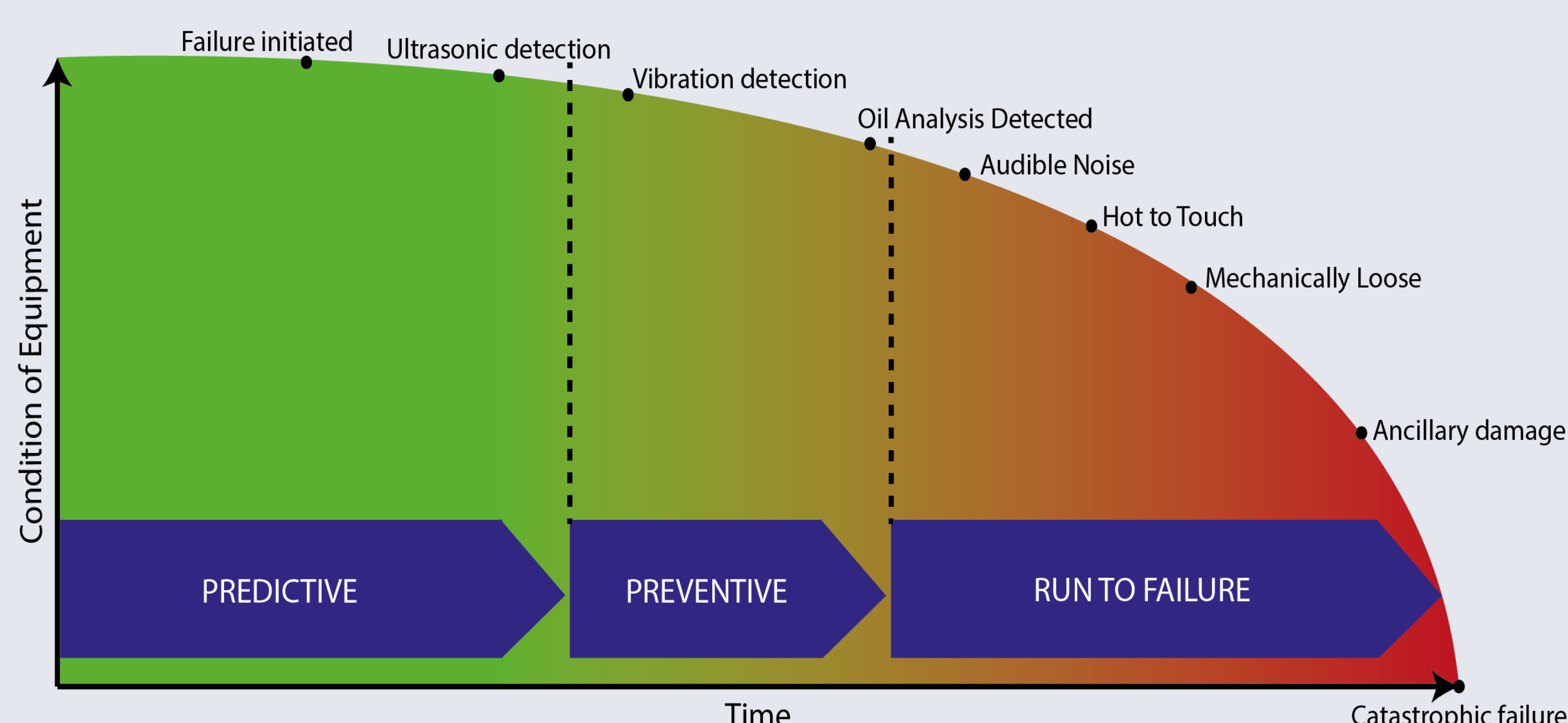
Methods and Findings

Our study has been made through a literature study and through empirical studies of onshore and offshore wind farms which has been in operation for more than a decade. Our findings are:

- Often too many visits to turbines are needed (even down to 11-15 days between visits)
- Parts and components of offshore wind turbines wear down in unpredictable and various ways
- Failure rates for installation, turbines and components do to some extent follow the bathtub curve (below) – but due to weather conditions planning of maintenance is still a challenge



- A number of different P-F-curves (below) illustrating the condition of equipment can be observed/developed for components, installations and a whole offshore wind farm – which makes Preventive and Predictive Maintenance challenging in a far offshore context



Conclusions and our further research

Our study has identified a number of different uncertainties and a need for further research in the establishment of places and organisations of work for Operations and Maintenance far from the coast. There is a need for:

- More focus on reliability and maintainability
- New maintenance strategies (e.g. by focusing on modularity)
- New supply chain strategies for spare parts, tools, and competences when technicians are available on site 24/7 but depending on a narrow weather window for work on turbines and installations spread out on a large area far from the coast.
- Offshore wind power is still immature and therefore there is a need for new and harmonized legislation for work when offshore wind farms are located and operated in different countries
- Reliability, availability and accessibility becomes key to improve Operation & Maintenance of far offshore wind power installations

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