Ørsted's approach to data-driven operations

Owner's and operator's perspective

Keynote at Virtual Wind II by ORE Catapult & Fraunhofer IWES

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Our vision

Let's create a world that runs entirely on green energy

Ørsted

Ørsted at a glance

74 %*
Offshore-Wind

Global market leader in offshore wind

Develops, constructs, owns and operates offshore wind farms in Denmark, Germany, the Netherlands, UK, the US and Taiwan

Development projects in UK, Germany, Taiwan and the USA

11 %*
Onshore-Wind

Develops, constructs, owns and operate onshore wind, solar and energy storage projects in the US

1 GW onshore operational capacity

15 %*
Markets & Bioenergy

Generates and sells power and heat to customers in Denmark and Northwestern Europe

Energy solutions forB2B customers

* Share of the Ørsted Group's capital employed, Annual Report 2019

Headquartered in Denmark

6,526 employees

Listed in the **NASDAQ DMX**, Orsted

EBITDA in 2019 EUR **2.34**bn

Revenue in 2019 EUR **9.1**bn

Phase out the use of coal by **2023**

Ørsted Offshore Wind Power

Status

- In operation
- Under construction
- Under development

Isle of man
Walney Extension
Walney 1 & 2
West of Duddon Sands
Barrow
Burbo Bank Extension
Burbo Bank

Westermost Rough
Hornsea 1
Hornsea 2
Hornsea 3
Hornsea 4
Lincs
Race Bank

United Kingdom

Gunfleet Sands 3
Gunfleet Sands 1 & 2
London Array 1

The Netherlands

Borssele 1 & 2

Denmark

Anholt

Horns Rev 1
Horns Rev 2

Nysted

Gode Wind 1
Gode Wind 2
Gode Wind 3

Borkum Riffgrund 3
Borkum Riffgrund 1
Borkum Riffgrund 2

Germany

25+ years of unparalleled experience and track record
26 Offshore wind farms in operation
3 Offshore wind farms under construction
6.8 GW constructed capacity
3.1 GW under construction
14 million Europeans with clean electricity
2.777 dedicated employees
23 partnerships

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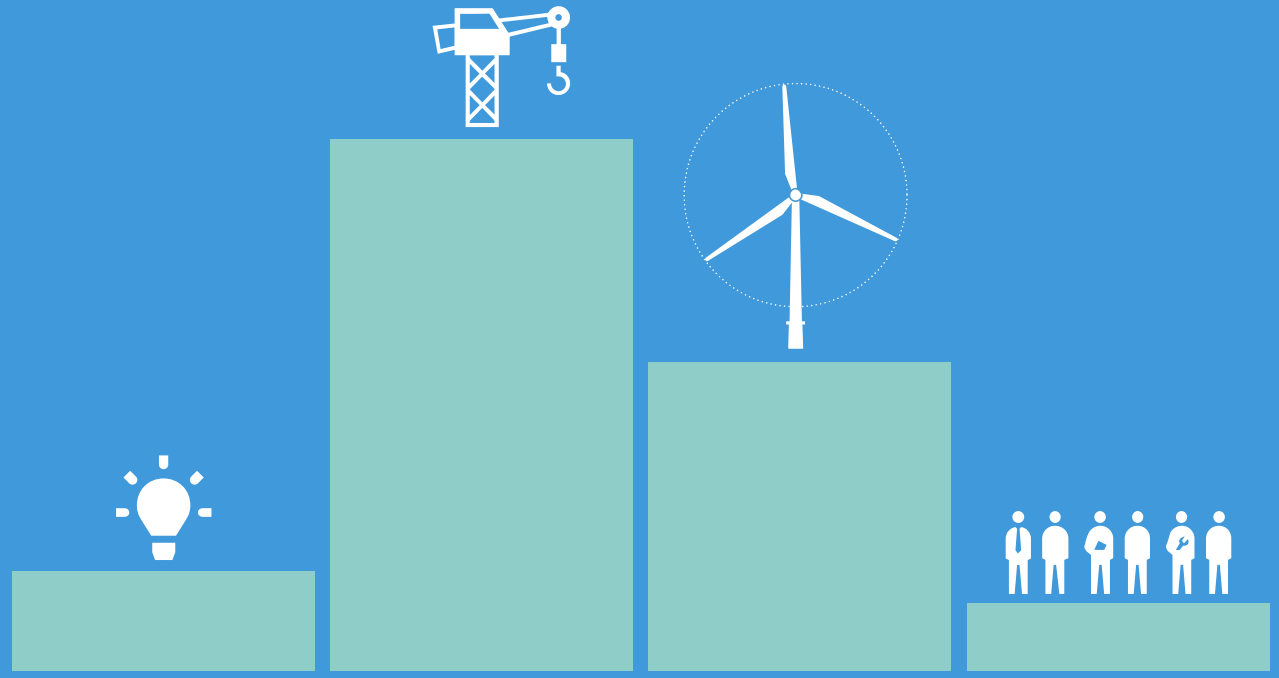
Ørsted's integrated end-to-end business model for Offshore Wind –

Share of employees over offshore wind farm life cycle



Develop
Identify and mature projects

Build
Manage construction, sourcing and supply

Operate
Conduct life-cycle maintenance

Own
M&A, attract capital through partnerships, asset management

Ørsted Wind Power core competencies

~2,700 Full-time employees

Ability to design and optimize projects with a 'total life-cycle cost of wind farm' mindset

Experience and expertise along the entire value chain allow for better understanding and management of risks

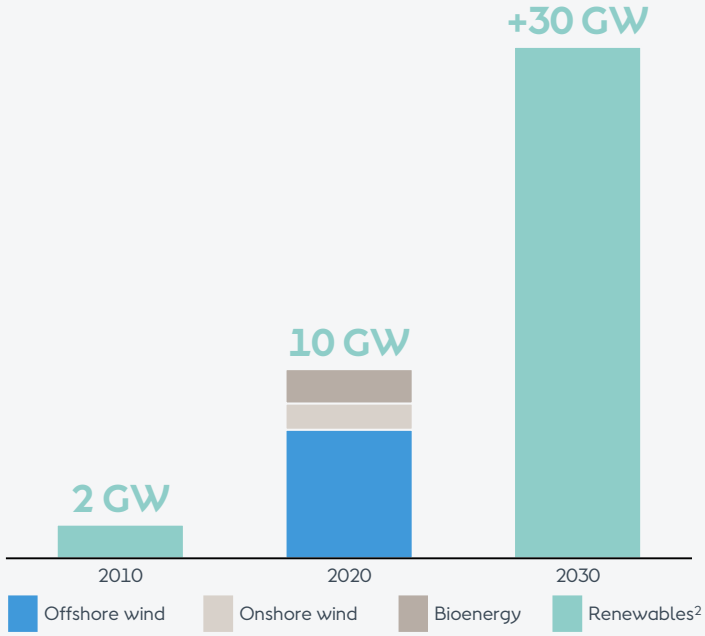
End-to-end model reduces LCoE through fast feedback and learning across the entire organization

Ørsted strategic transformation

Green share of power generation ~99% in 2025, approximating zero emissions

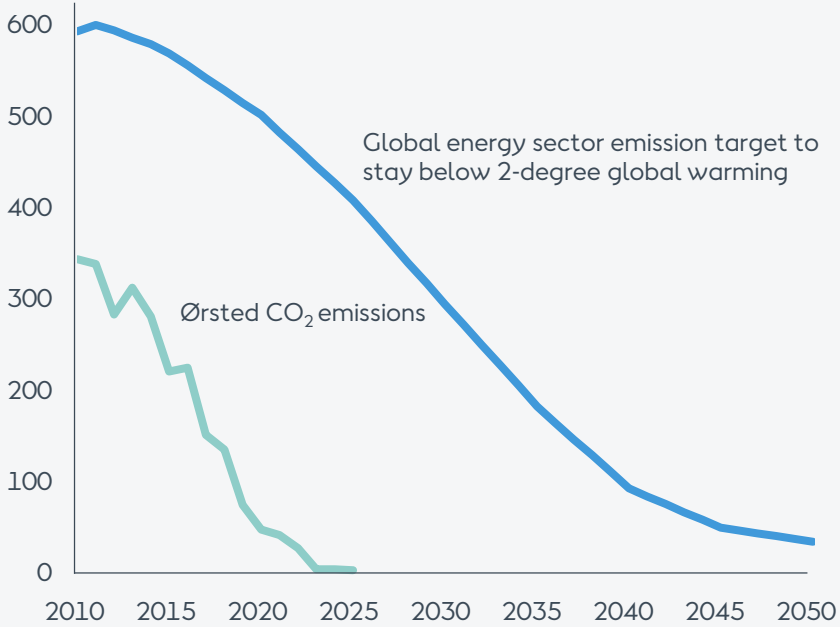
Ørsted installed renewables capacity

GW



Carbon intensity of power and heat generation

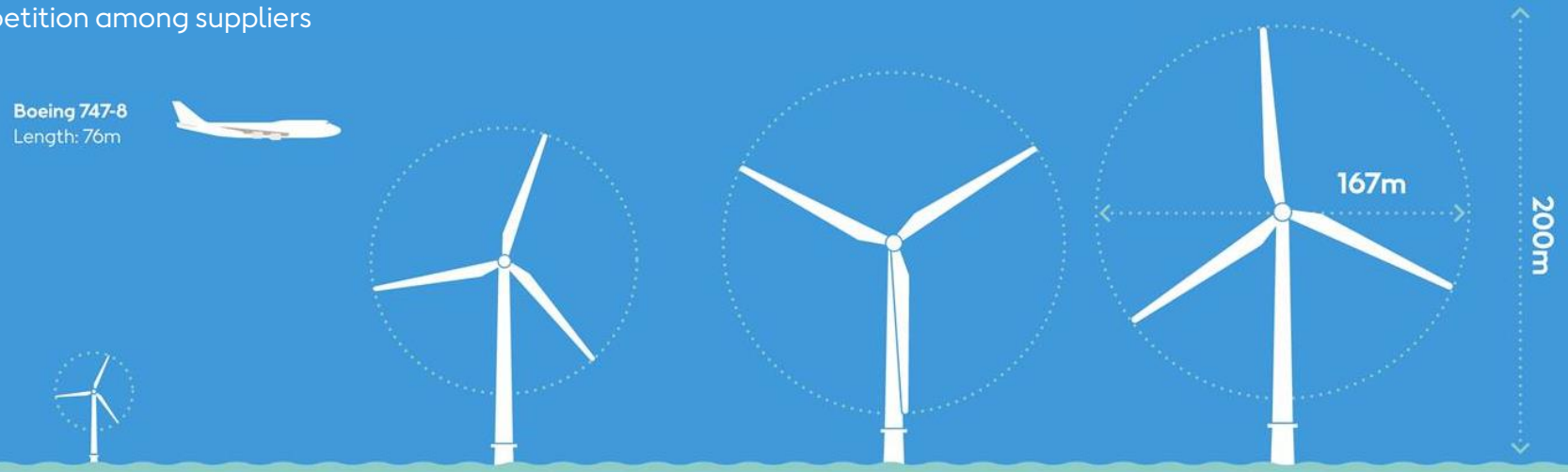
gCO_2e/kWh



We're building more and larger wind turbines

Factors of cost reduction

- Larger wind farms and larger turbines
- Optimization of manufacturing processes
- Reduction of the construction period
- **Reduction of operating and maintenance costs**
- Competition among suppliers



Wind turbine no. 1
Vindeby, Denmark
Year: 1991
Diameter: 35m
Capacity: 0.45MW

Wind turbine no. 500
Walney, UK
Year: 2012
Diameter: 120m
Capacity: 3.6MW

Wind turbine no. 1,000
Gode Wind 1 & 2, Germany
Year: 2016
Diameter: 154m
Capacity: 6MW

Wind turbine no. 1,500
Borssele 1 & 2, The Netherlands
Year: 2020
Diameter: 167m
Capacity: 8MW

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Our story

Ørsted Lab established in 2016.

Built on data and experience from Ørsted's global operations.

First product release available and creating significant value at Wind Farms after less than a month.

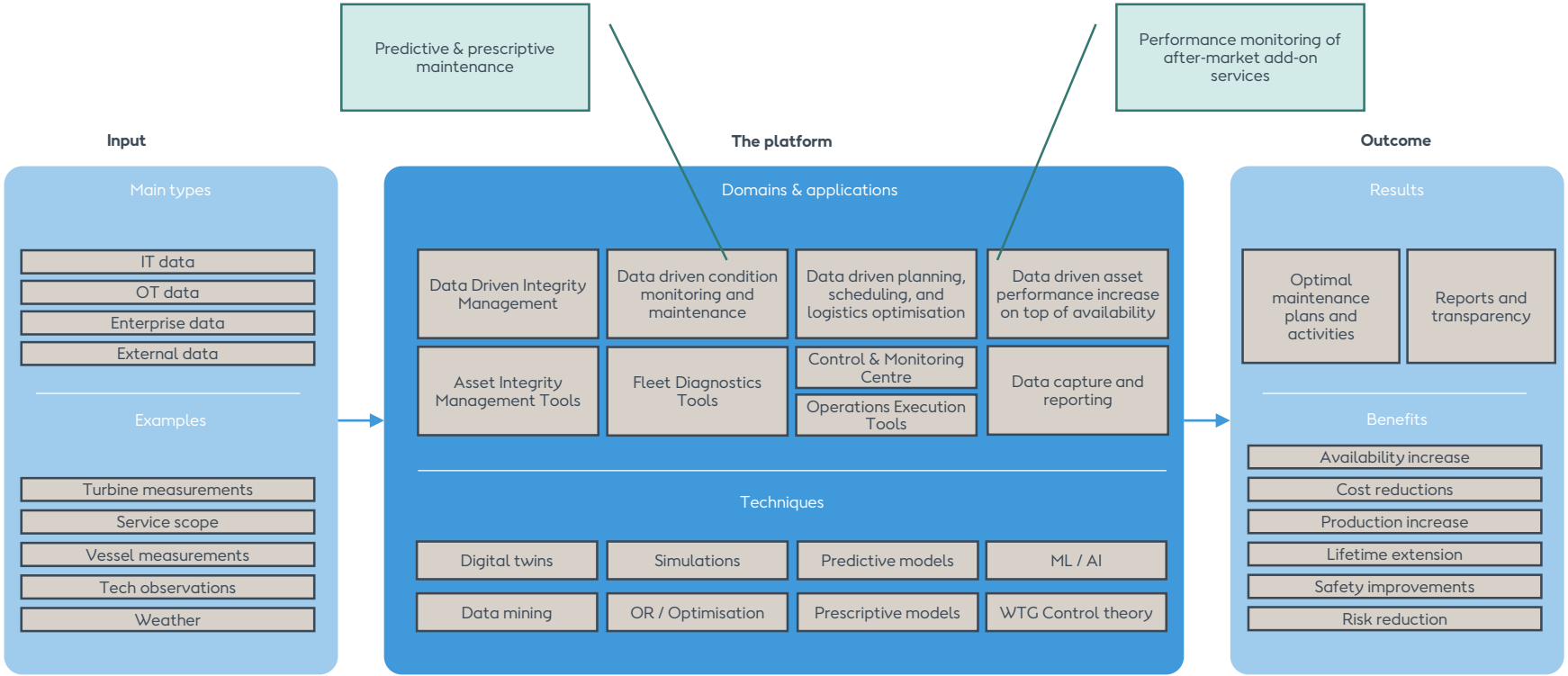
Data driven insights and advanced analytical models are used to mitigate the risk of wind farm operation and increase profits.

slides on
the Ørsted lab
kindly provided by

Simon Foss Børresen

**Head of Advanced Analytics |
Product Manager Ørsted Lab**

Our platform enables us to take optimal, data driven decisions across the value chain – and ensure execution throughout the line

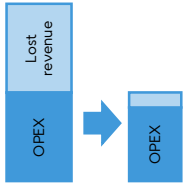


Actual product examples

Predict failure and advice to replace components before turbine stops

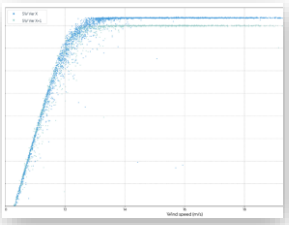
When a converter cabinet fan fails, the turbine stops

A data driven model detects fans about to fail, and **advice to replace** is issued



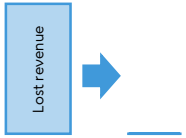
The site can schedule a visit to the turbine and avoid production losses between failure and repair

Detect & classify underperformance in after market add-ons **and advice to reinstate agreed performance**



A software update resulted in the turbines being curtailed in certain situations

A data driven model detects and classifies the underperformance, and **focussed dialogue** with add-on provider is initiated



Guaranteed performance reinstated. Loss recovered

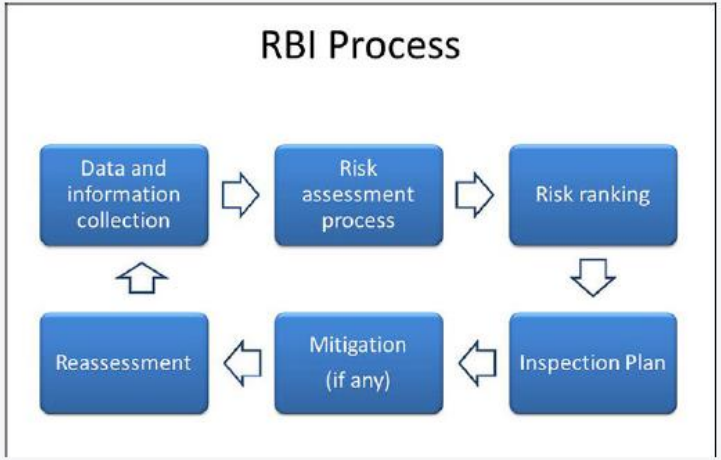
Ørsted Lab_

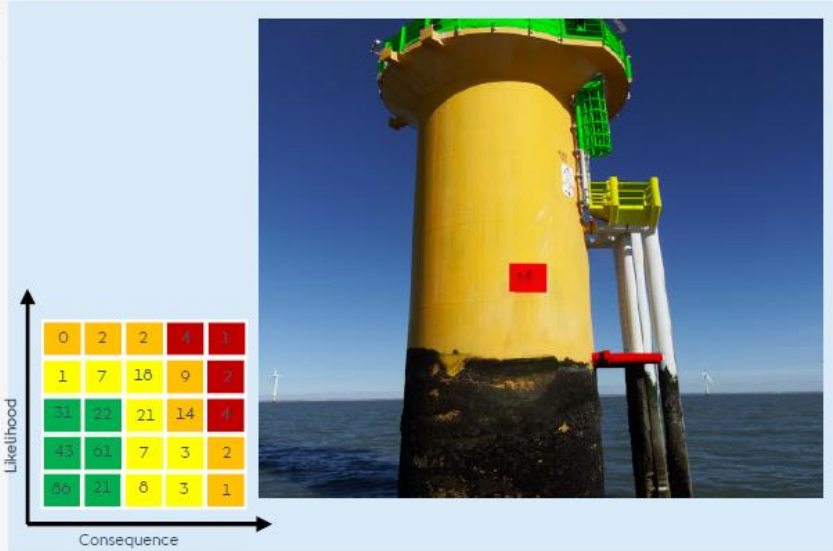
We help make wind work_

What is Risk Based Inspections (RBI) ?

Combining operational experience with advanced analytics to improve inspection plans

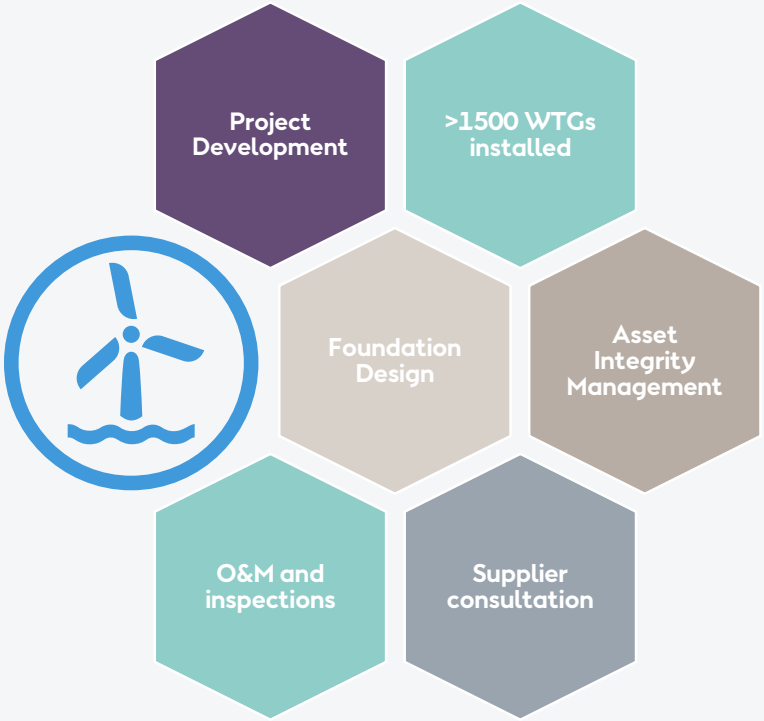
Risk = Likelihood of failure X Consequence of failure





Ørsted's 'enablers' for Risk Based Inspections and data driven operation

In-house core competencies, close collaboration with suppliers & existing operational base



Methodology of RBI vs. Prescriptive

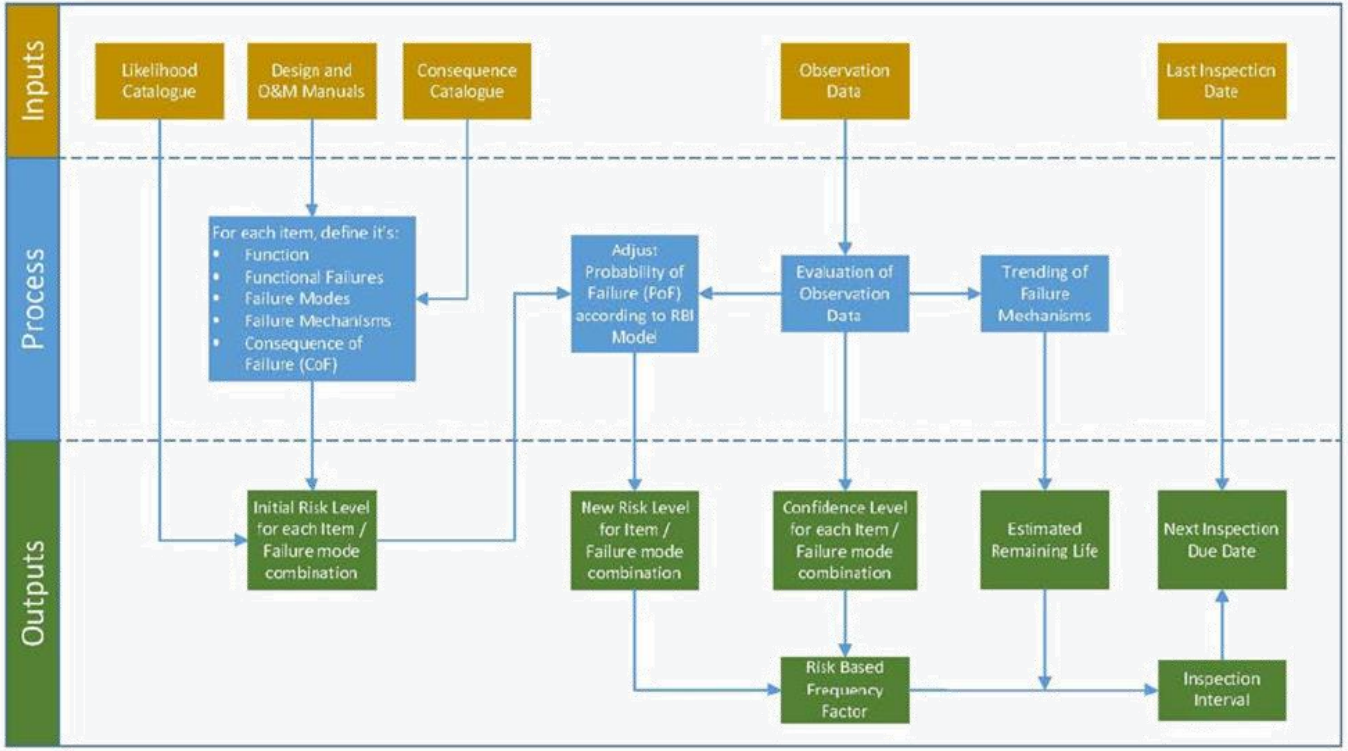
Prescriptive approach

- Fix inspection intervals both for critical items (e.g. yearly) as well as non-critical items (e.g. once every 5 years = 20% annually)
  - No systematic update based on new information
  - Low confidence that most important areas are being looked at
  - Large volumes of data

Risk Based Approach

- Inspection of a few representative structures in accordance with a risk based inspection plan
- Risk ranking created on all items based on likelihood of failure and the consequences of failure
  - Ranking continually updated based on current condition
  - High risk elements used to create inspection scope (Technical control of risks)
  - Clear identification of high risks allow management decision on acceptance of risks (Financial control of risks and inspection costs)

RBI Model Development and Risk Assessment Process



Digitalisation is a tool of choice to scale our business capabilities

Ørsted

Love your home

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