Methodology for Risk Assessment of Floating Wind Substructures

Roberts Proskovics, Offshore Renewable Energy Catapult

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Qualification of innovative floating substructures for 10MW wind turbines and water depths greater than 50m

The research leading to these results has received funding from the European Union Horizon2020 programme under the agreement H2020-LCE-2014-1-640741.

Contents

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- Methodology developed
  - 4 risk areas
- Conclusions

Introduction

- A Horizon2020 project – LIFES50+
  - Qualification of innovative floating substructures for 10MW wind turbines and water depths greater than 50m
  - 40 months duration
  - 7.3M€
  - 12 partners
- Work package 6 – Uncertainty and risk management
- Developed for LIFES50+, but applicable outside

Introduction

- LIFES50+ Consortium

DTU Danmarks Tekniske Universitet

Universität Stuttgart

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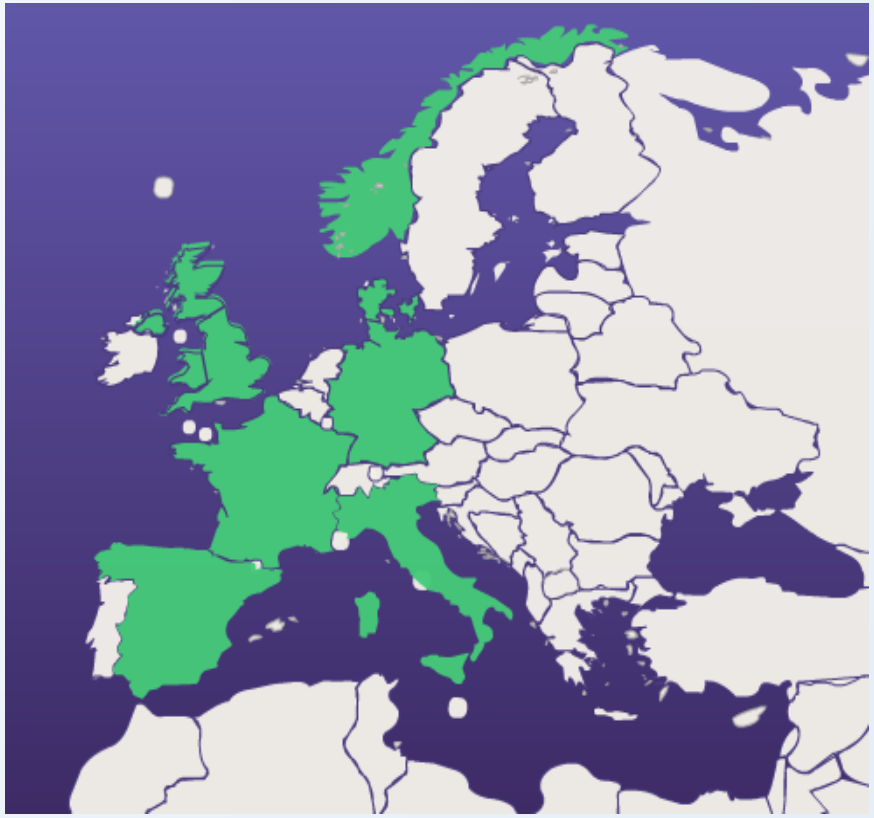
RAMBOLL

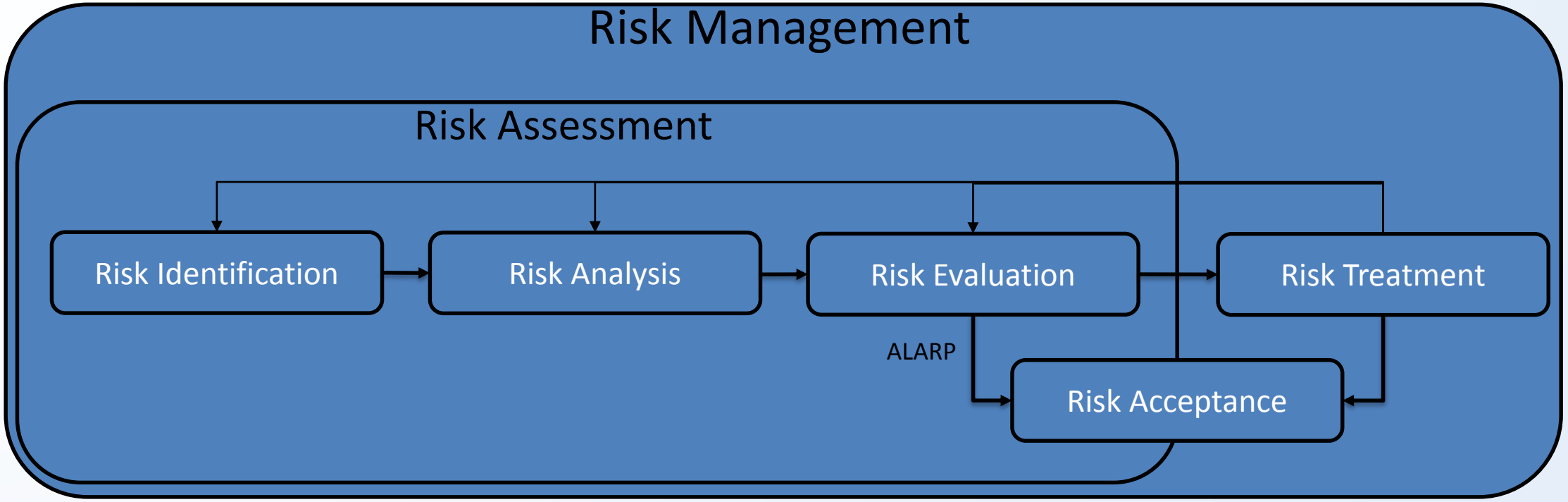
IREC Institut de Recerca en Energia de Catalunya Catalonia Institute for Energy Research

DNV·GL



Map generated on www.travbuddy.com

Risk Assessment and Management



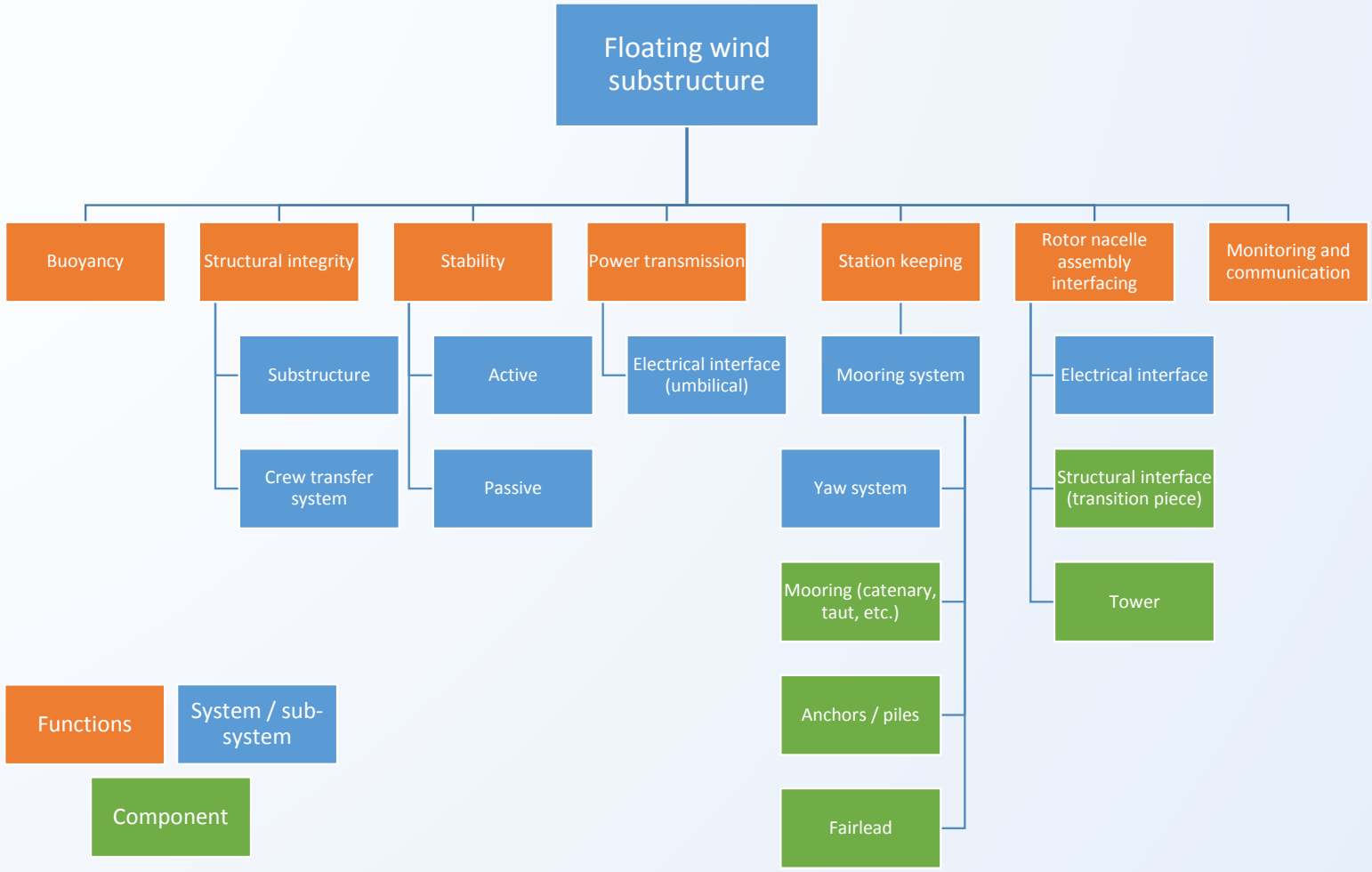
Methodology – Introduction

- Why?
  - No dedicated risk assessment methodology for floating wind
- How?
  - Risk areas considered
    - Technology
    - Health, Safety and Environment (HSE)
    - Manufacture
    - Commercialisation
  - Covers all life cycle phases
  - Based on common techniques, but updated to meet specific requirements
  - Mostly qualitative

Methodology – Technology Composition

- Floating substructure is integration of multiple element technologies
- Technology composition analysis allows for:
  - Improved understanding of the system being analysed
    - Identify its elements
    - Identify interdependencies
  - Early risk identification
- Split into
  - Functions (e.g. stability, structural integrity)
  - System and sub-systems (e.g. crew transfer system, mooring system)
  - Components/elements (e.g. anchors, transition piece)

Methodology – Technology Composition



(Example functional hierarchy from LIFES50+ 'Risk Management for Deep Water Substructures')

Methodology – Technology Categorisation

- Advances in technology are generally evolutionary
- Only some elements of technology are typically novel
- Dimensions of uncertainty of technology
  - Novelty
  - Application
- Technology categorisation prioritises areas of most uncertainty/risk

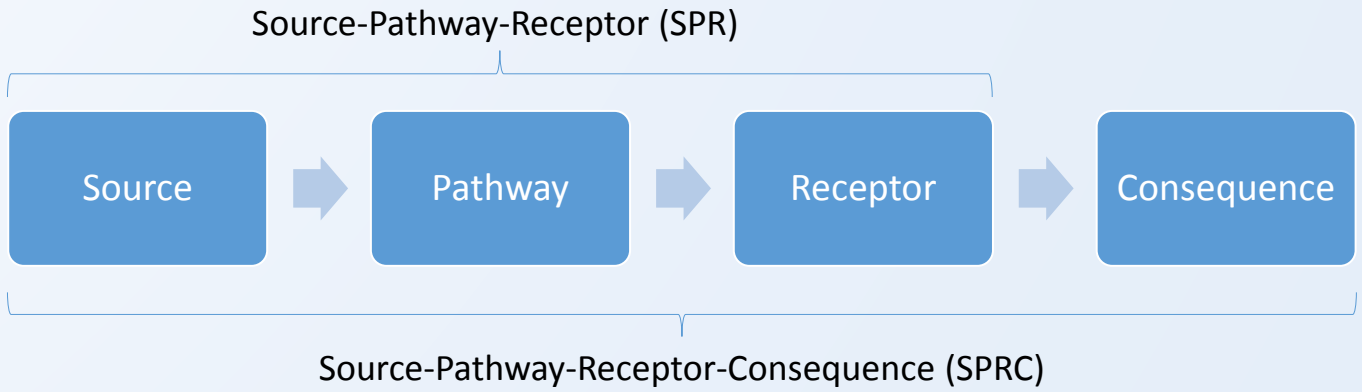
Application Area	Degree of Novelty of Technology		
	Proven	Limited Field History	New or Unproven
Known	1	2	3
Limited Knowledge	2	3	4
New	3	4	4

Technology Category	Indicator
1	No new technical uncertainties (proven technology)
2	New technical uncertainties
3	New technical challenges
4	Demanding new technical challenges

(DNV GL, DNV-RP-A203 'Qualification of New Technology', July 2011.)

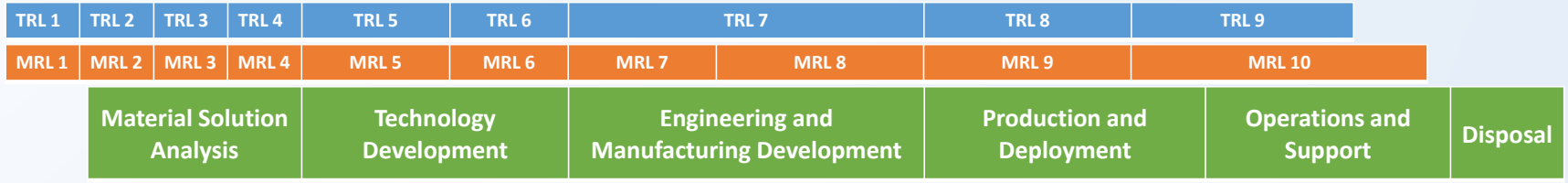
Methodology – HSE

- Split into
  - Health and Safety
  - Environment
- Health and Safety
  - No dedicated H&S standards for floating wind or even offshore wind
  - RenewableUK risk categories (24) + some specific FOWT categories
- Environment
  - Source-Pathway-Receptor
- 4 dimensions of risk
  - Risk to personal injury
  - Potential pollution/societal losses
  - Potential economic consequence
  - Risk to human life



Methodology – Manufacturing

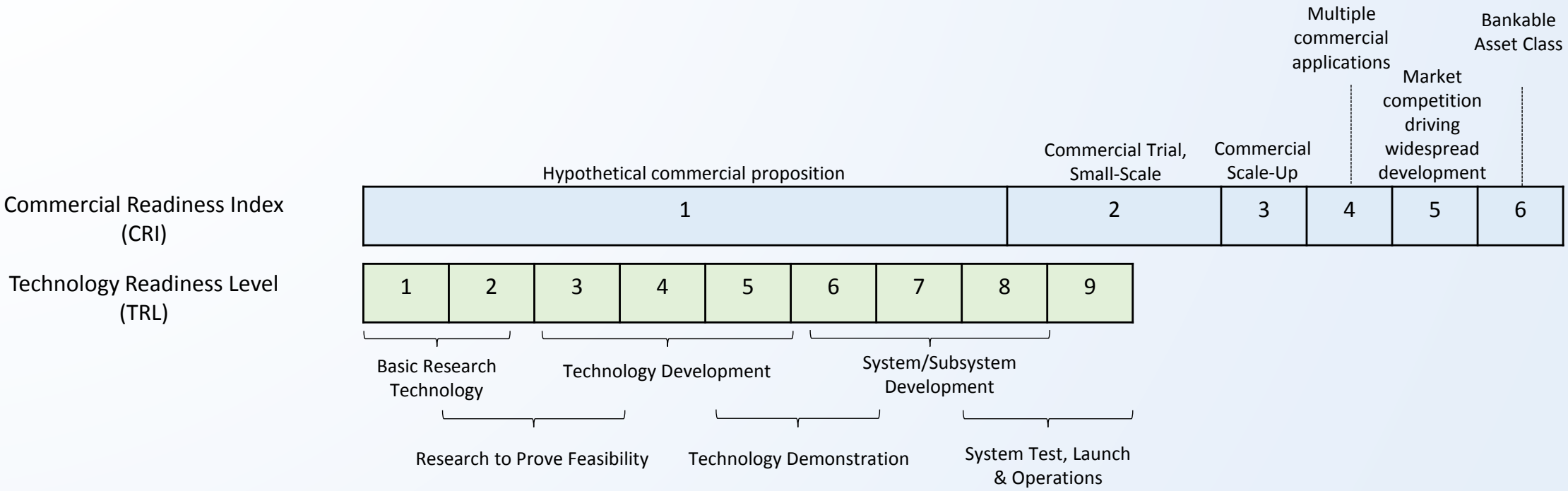
- Proposed to use Manufacturing Readiness Levels (MRLs)
  - MRLs vs TRLs
  - Manufacturing risk areas (9 threads, 22 sub-threads)
  - 3 dimensions of risk
    - Cost
    - Schedule
    - Quality
- Risk treatment
  - Manufacturing Maturation Plan (MMP)



Methodology – Commercialisation

- Proposed to use Commercial Readiness Index (CRI)
  - 6 levels (hypothetical commercial proposition to bankable asset class)
  - CRI vs TRL
- Dimensions derived to judge commercial readiness:
  - 8 dimensions
  - 18 sub-categories

Methodology – Commercialisation



(ARENA, 'Commercial Readiness Index for Renewable Energy Sector', 2014)

Conclusion

- Developed a bespoke methodology
  - Will be tested in the following months
  - Reduce risk
  - Make FOWTs more attractive to investment
  - Reduce LCoE (main aim we all are striving for)
  - Applicable outside of floating substructures for floating wind
- D6.1 publicly available from 02/2016

Thank You!