

Risk Assessment of Operation and Maintenance of Wind Turbines in the Arctic

PhD. Albara Mustafa

Prof. Abbas Barabadi



The Arctic University of Norway UiT
Department of Engineering and Safety

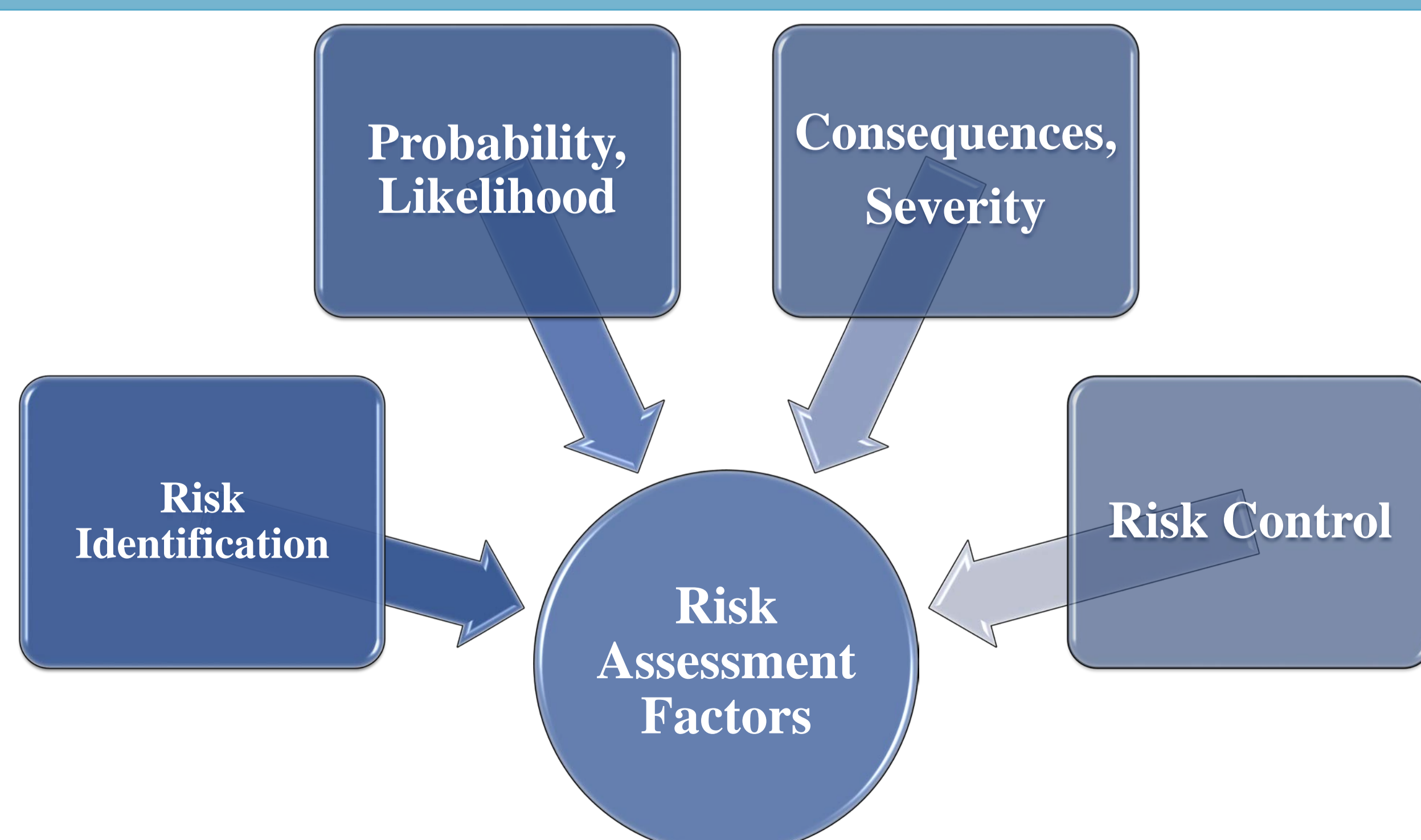
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Introduction

- **The available wind power** in cold climate regions or in the arctic is **almost 10% higher** than in other regions, due to **higher air density**. Therefore, wind turbines are invested in this region.
- There are different risks related to wind turbines in cold climates. **Ice accumulation** on wind turbines' **blades** is a main concern and has **sever consequences** for the wind turbines and their surroundings.
- Ice can be **thrown away** from wind turbines and hit people, animals, cars, other wind turbines and nearby structures.
- **Ice accumulation** on the blades can create **imbalance, vibration** and affects the **structural integrity** of the wind turbine.
- Low temperatures can change the dimensions and mechanical properties of the mechanical components of the wind turbine and **cause failure** to them.
- Snow accumulation on the **roads** and the **foundation** of the wind turbine can prevent maintenance crews from reaching the wind turbine to carry out the **required maintenance**.
- Windy weather conditions accompanied by snow or precipitation can make the maintenance work even more difficult.
- Ice accumulation on the blades will **increase the noise levels** and become **annoying** to people living nearby and to operation and maintenance crews.
- Icing and cold climate related standards have progressed in recent years. However, cold climate wind energy is one of the largest **“non-standard”** markets in wind energy today.

Risk Assessment

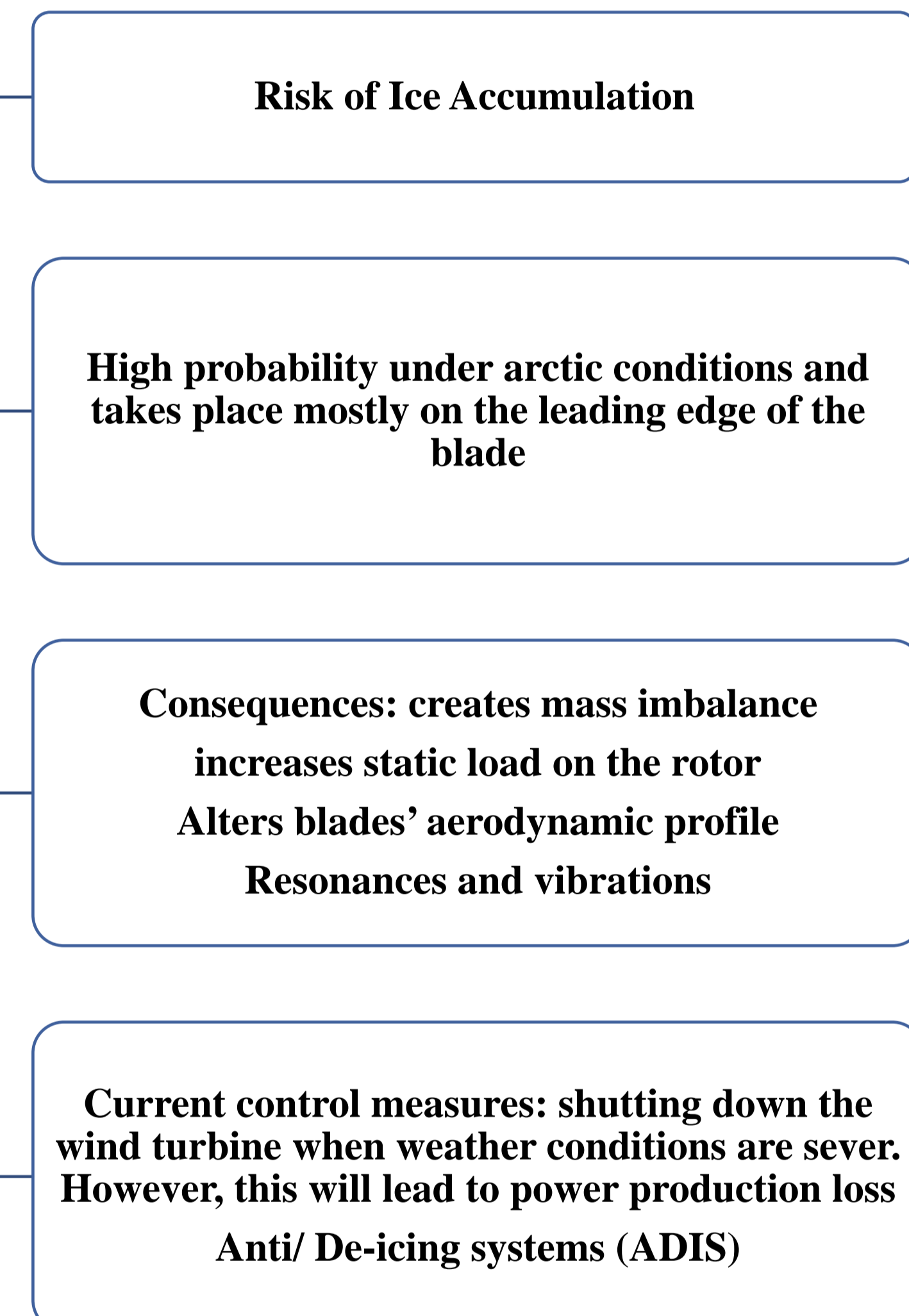
- **Risk assessment** aims towards **identifying** the risk, **analyzing** it through defining the **probability** of that risk to take place and the **consequences** of it, **evaluating** the risk through comparing it to **certain criteria**, and based on that **suitable measures** are taken into account in order to **mitigate the risk**.
- Risk assessment provides **decision-makers** and responsible parties with an **improved understanding of the risks** that could affect the **operation and maintenance activities** of wind turbines.
- Decisions based on proper risk assessment will help in **increasing the power production** of the wind turbines by **decreasing their downtimes**.



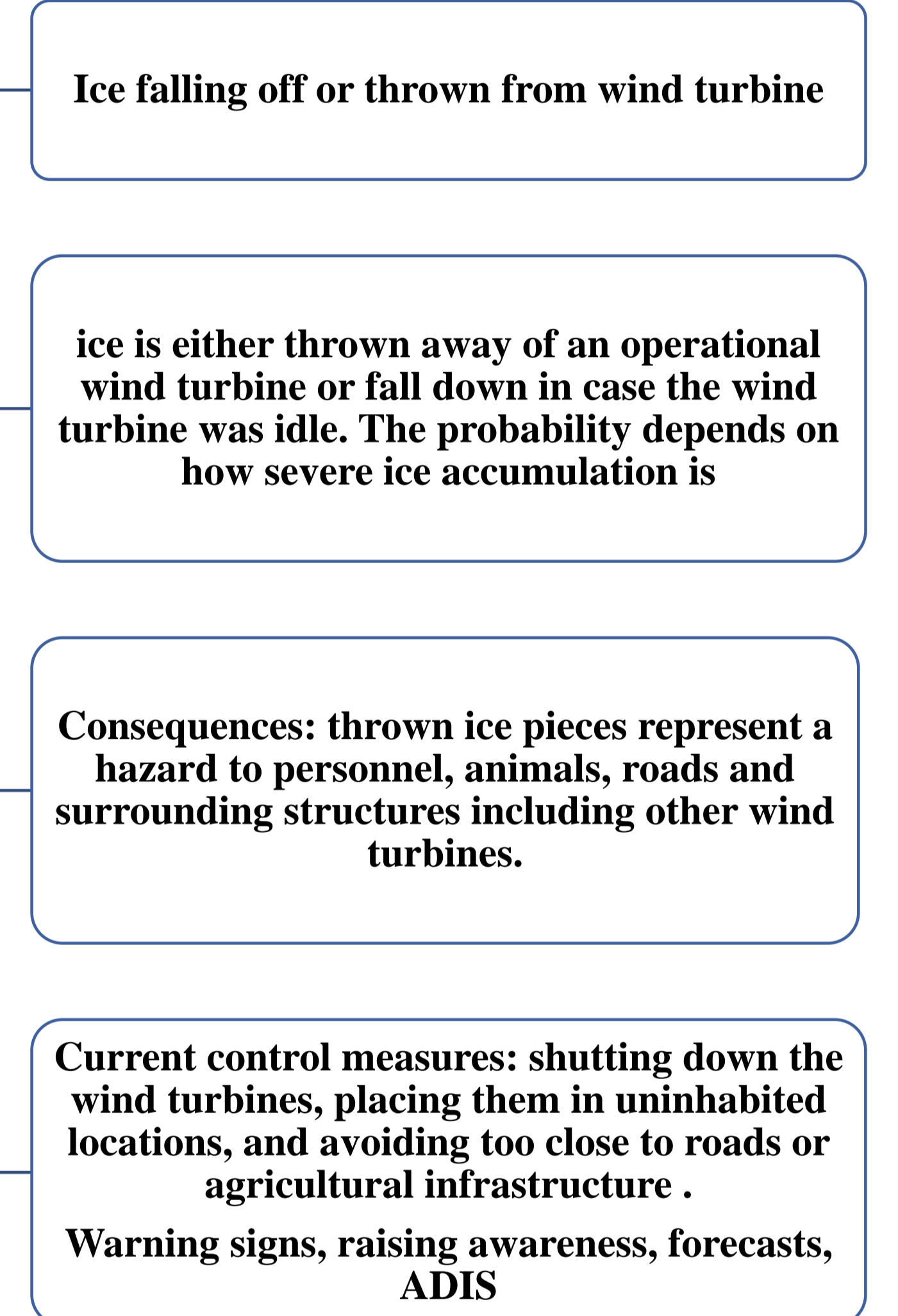
Risk assessment examples

- Risks related to wind turbines in the Arctic can be categorized into **two categories**:
 - Risks **generated by the wind turbines**, affecting the surroundings.
 - Risks **generated by the surroundings and environment**, affecting installed wind turbines, maintenance and operation crews.

Risk generated by the surroundings and environment



Risk generated by wind turbines



Expected outcomes of this research

- Defining risks affecting the operation and maintenance activities of wind turbines installed in the arctic region.
- Defining suitable **risk assessment methodologies** to be followed for risks related to wind turbines in the arctic.
- Improving **standards, guidelines and best practices** to include dealing with different types of risks affecting wind turbines' operation and maintenance activities.

Defining Risks

Selecting Best Risk Assessment Methodologies

Improving Standards and Guidelines