# A Bayesian Network model for Risk-analysis System on Oil Spill Response Effectiveness in the Canadian Arctic

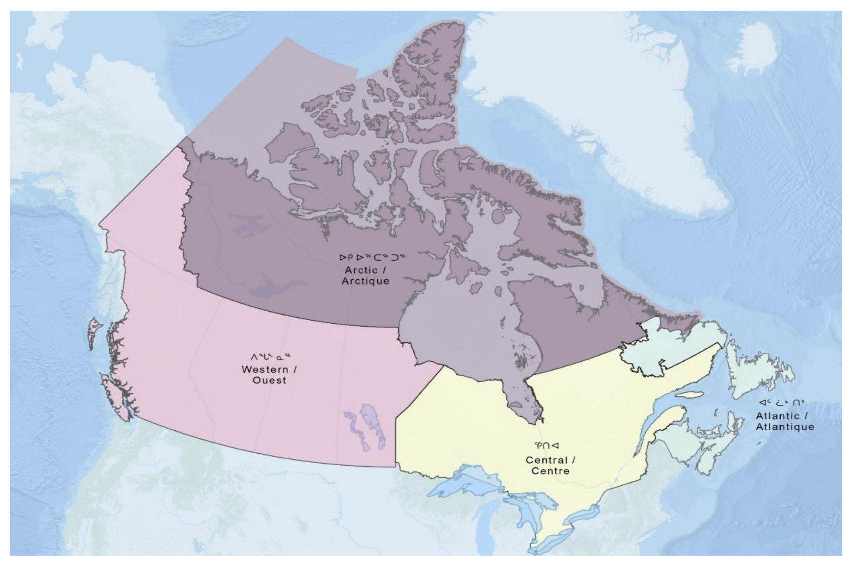
Talah Al Sharkawi, MASc in Industrial Engineering, Halifax, NS

## Background & Context

### Background

Oil spill accidents are a serious global problem; hence an effective emergency preparedness planning is required to help develop prompt solutions for the incidents. Creating proper emergency preparedness planning requires planners to develop a specific way of thinking that will analyze the various human, cultural, and environment impacts in a complex setting.

There are various marine-related activities in the Arctic such as shipping activities, tourism, fisheries, research, mining, and offshore oil drilling.



### Mechanical Recovery

Mechanical Recovery is an oil spill response method that retrieves oil from the water surface and then eventually disposes of it elsewhere. It is the process of removing oil from the water surface utilizing a skimming device or direct suction and pumping recovered fluids to a storage system.

It utilizes both booms and skimmers. Booms function to limit the spread of oil and concentrate it for recovery, while skimmers function to remove oil from the water surface and Typically, the selection of mechanical recovery will be the first choice.

### Chemical Dispersant

Chemical dispersants add chemicals to the oil surface and/or slick to aid in advancing the process of dispersion of the oil droplets into the water column .
The decision regarding using dispersants in the Canadian Arctic involve negotiations on the benefits and costs in the presence of high uncertainty.

The Dispersants work by breaking up oil slicks into tiny oil droplets that are then mixed into the water column. The benefits of using the dispersants can include reduction of surface oil and enhancing the natural biodegradation due to the oil surface being substantially increased. They can be deployed through vessels or aircrafts.

### In-situ Burning

In-situ burning is the term given to the process of burning floating oil at sea, at or close to the site of a spill.
Burning oil at seas in ideal conditions, has the potential to remove large amounts of oil from the sea surface.

Although, the decision on whether or not to burn oil in water is often complex. The fire and potentially toxic smoke have the potential to impact human health and in the case of using this response in the Canadian Arctic oceans, there are concerns with the potential impact of soot deposits on the rate of melting ice.

## Problem Definition

The main research question guiding this study is: Based on the conditions set on the Bayesian Network Model made on oil spill recovery process, how effectively can the system operate within those set conditions. To properly answer the dilemma on how effective the response is, first the model is made. Once the model was made, multiple oil spill scenarios were applied in the model to potentially give the required answers.

The research objective is centered around effectiveness based on operability of recovery equipment and aftermath(cleanup) for oil spill recovery process. (how well that equipment is able to clean up oil spill).

A model needs to be created as an analysis support where different spill types, clean-up technologies, human and environmental conditions are considered. By creating a model, one can tell what a system is doing under certain conditions and the factors and relationships that bring about this behaviour.

### Acknowledgments

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### References


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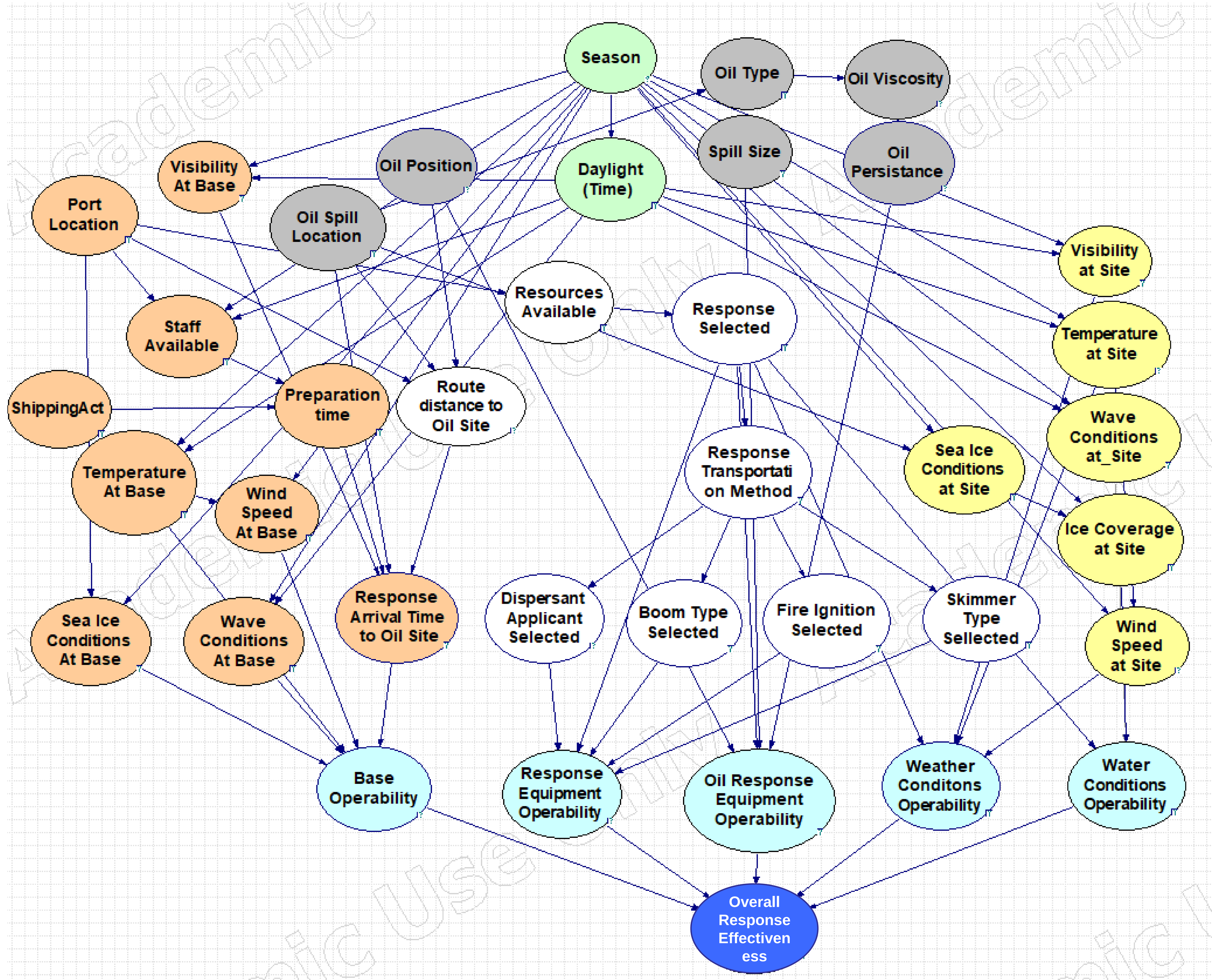
## Methodology & Results



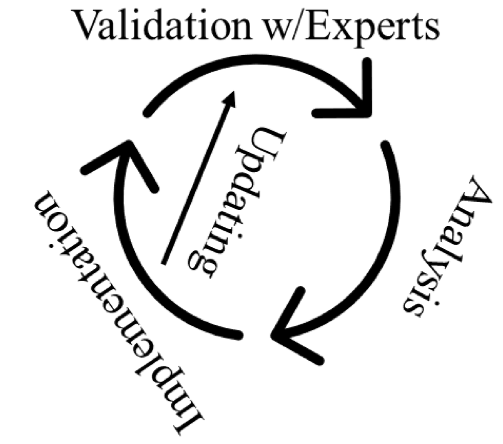

Legend

Site-related Variables | Operability Variables | Oil-related variables | Response-related variables | Base-related variables | Season & Time | Effectiveness

Each oil spill is unique, and with several variables that can influence the environmental conditions, can eventually influence the operability of the oil spill response equipment used to combat the oils.

To investigate the effectiveness of the three different responses selected: In-situ Burning, Chemical Dispersion, and Mechanical Recovery, different types of operability were formed to look into how "good" the operability is:

1. Base Operability
2. Response Equipment Operability
3. Oil Response Equipment Operability
4. Weather Conditions Operability
5. Water Conditions Operability




A Bayesian Network Model will be used to aid in the intricacy of oil spill responses by identifying and developing scenarios for planning and seeking to understand vulnerability to potential spill responses. This proposed technique will guide in the analysis of various oil spill response equipment efficiency. In order to aid in the model's accuracy and validity, expert's opinions (both from research and/or responders) were inputted to help achieve this.

Experts that accepted, agreed to be anonymous and attended interview process which was around a 2-hour online session. Expert revision is then repeated a couple of more times until a satisfactory model has been developed. Each new revision was based on the most updated model developed.