

Executive Summary

Challenging opportunity in the Northern Sea Route (NSR) future: Sailing under Ice risk and hazard

The Arctic is warming at a faster rate than anywhere else on the planet, and as a result, sea ice in the Arctic Ocean is decreasing. According to the National Snow and Ice Data Center (NSIDC), Sea ice loss has far-reaching effects on the planet, as the ice helps regulate Earth's climate, influences global weather patterns, and impacts ocean circulation.

The Northern Sea Route (NSR), situated within the Arctic environment, is the shortest maritime link between Western Europe and the Asia-Pacific region, running along the Russian Arctic coast. While historically challenging due to ice, the route's usability is increasing as Arctic ice melts and Russia invests in icebreaker fleets and infrastructure. The NSR is a vital strategic and economic pathway, primarily for Russian oil and gas, but increasingly for other cargo, such as exports from Eastern and Southern Asia, commodities and trades.

With the opening of the Northern Sea for international shipping routes, various vessels prefer to use this option to reach Europe, as the distance is significantly reduced if a ship sails through this route. At the same time, the demand to ensure ship safety rises as the impact phenomenon between ship structures and ice causes numerous casualties. Finite element analysis with a concentration on the contact between ship structures and ice levels is considered. The double hull of a chemical tanker was modelled with a shell element, while a deformable characteristic was implemented on the ice as an indenter. Several target areas on the side structure were designated as impact points based on their stiffener components. Different models of indenter were considered to observe the structural responses and the influence of external parameters, namely ice topology.