This paper is framed in the context of the EU Interreg IVB North Sea Region project Food Port. In line with this project, this paper aims to define mathematically cost and time models able to provide realistic information about the performances of road haulage and of intermodal chains using short sea shipping (SSS) in the North Sea Region (NSR). The models integrate the necessary variables to establish the impact of different fleets and SSS features on the competitiveness of intermodal chains for the movement of food related goods. The models were applied to evaluate the opportunities for the success of intermodal chains using the Rosyth-Zeebrugge route. The results obtained validate the utility of the models and they suggest possible changes to the current operation of this SSS service in order to increase the marked potential possibilities for the intermodal chains through Rosyth-Zeebrugge.