Introduction
We consider the distribution of goods from manufacturers to customers by a logistics provider, where manufacturers’ supplies and customers’ demands are given and cannot be controlled. The goods may temporarily be stored in warehouses to compensate for the stochastic behavior of the supplies and demands. Manufacturers, warehouses and customers are geographically connected by transportation links, e.g. roads, railways, waterways (see Fig. 1).

The problem of a logistics provider is to determine which links to use and how much to ship through them, such that costs are minimized and demands are met.

Objective
The objective is to find network topologies, that are cost-effective in a wide range of situations since supply and demand distributions may change in time.

Methods
We introduce a method to find a cost-effective network topology by deriving a general mathematical model, which describes the flows through such a network. Model predictive control with a receding horizon (MPC) is used to determine the optimal routing schedule for a given topology along a certain time period (layer 1). A heuristic is proposed to determine the costs dependent on the number of deleted links in the network (layer 2), see Fig. 2.

The order found for deleting links is used for five different sets of supplies’ and demands’ time series to validate the robustness.

Results
Results of the optimization are depicted in the left plot of Fig. 3 for \( m = 6, w = 3 \) and \( c = 7 \). When the number of customers is large only 5% of the links is necessary to obtain close to minimal costs. The right plot indicates that the same reduced network yields close to minimal costs as long as the means of supplies and demands remain the same.

Conclusions
The proposed optimization methodology finds a cost-effective network with a very limited number of links. This topology is only sensitive to changes in the means of supply and demand distributions. Hence, with only information about the individual means a close to optimal topology can be constructed, independent on the variability in supplies and demands.