WP 4.2 **Case Study 2**	European Union The European Regional Development Fund The Interreg IVB North Sea Region Programme foodport Connecting Food Port Regions Between and Beyond
Project	*Tests to achieve a longer shelf life for fresh fish*
Project	**FOOD PORT - *Connecting food port regions - Between and beyond***
Project team and organisation	Deutsche See GmbH Team: • Wolfgang Zeitz, Logistics Manager • Konstanze Behrmann, Quality Manager
Domain/Context	To realize a modal shift someone must take in account that food products, especially fresh food products, have a very short shelf life. If you change the transport mode, you have to find out new techniques that achieve a longer shelf life, so that these products reach the point of destination in the same quality as before.
Description	For these tests Deutsche See has bought a reefer container with a special new technique which allows to adjust the humidity and gas composition. On the other hand we've made tests with big sealed crates with modified atmosphere inside. At the moment we get redfish fillets from Iceland by air and whole gutted salmon from Norway by truck. Air transport takes one and a half day from Iceland via airport Cologne to Bremerhaven and the road transport from Norway to Bremerhaven 2 to 3 days. A short sea shipping transport would take 5 to 8 days from Iceland to Rotterdam by the shipping companies Samskip or Eimskip and 5 days from Alesund Norway to Bremerhaven by the shipping company Seago. But someone has to take in account, that you must add 2 days in every harbour for administration That means that the shelf life of the fresh fish needs to be extended with a minimum of 5 days to get the fish in the same condition in terms of freshness as today. To achieve this target we put the fish in our reusable boxes and adjusted the humidity in the container to a level over 90 % and reduced the oxygen to a level below 4 %. We have kept the fish in this container for at least ten days and did an examination of the fish quality every second day. The same we did with fish which was packed in sealed crates under modified atmosphere with 60 % CO_2 and 40 % N_2. These crates were also put in the same reefer container and left them there with a temperature of 1° C. For these tests we have used different types of fish: redfish, cod and salmon.

	We have stored the fish in the container without water ice for cooling, which can be considered as a major advantage of this new technology, because you save energy and water for the production of water ice. On the other hand you can put more fish into the boxes because today 25% of the volume is water ice.
Target(s)	Find out a new technique to achieve a longer shelf life of the fish that makes a switch from air or road transport to short sea shipping viable. In this way one can make the transport of fish more sustainable.
Process and time line	STEPS UNDERTAKEN **Step 1**: November 2010 First transport of fish (salmon and cod) in a (leased) reefer container from Norway to Hamburg. Examination of the fish by the Max Rubner Institute in Hamburg. Very bad results. Fish was rotten. We thought because of the unhygienic conditions in the container. We decided to buy an own container with the technique to change the atmosphere inside. This allowed us to take the responsibility of both cleaning and disinfection. **Step 2**: March 2011 Second test with salmon and cod. We stored the filets in crates with water ice and in crates with modified atmosphere in a storage room with a temperature of 0°C. Every second day the fish was examined by the Max Rubner Institut. The intermediate results: cod filet was no longer suitable for consumption after the 7th day in the crates with modified atmosphere. The fish was not suitable for consumption after the 6th day. The salmon filets after the 13th day in ice and after the 15th day in modified atmosphere. **Step 3**: July 2011 Third test with salmon and cod. The same test conditions as in Step 2 with one difference. Before we put the filets into the crates with modified atmosphere we chilled them for 4 minutes in a deep freezer with – 78°C so that the temperature on the surface of the fish was -1°C. The intermediate results: the bacterial growth was less than in step 2 we got 2 days more shelf life when the fish was packed in crates with modified atmosphere. **Step 4**: September 2011 The first tests were with our container with the technique to change the atmosphere inside. We made 4 test series with fish pieces. Fish pieces are the parts of the fish which you cut away in the production. Normally you don't sell these parts of the fish to consumers. We made the tests with this kind of fish because we were not as confident in the new technique so that we wanted to reduce the risk of the loss of the fish to a minimum. 1. We put fish in our crates with water ice; 2. We put fish in our crates without ice; 3. We put fish in sealed crates with modified atmosphere without pre-chilling; 4. The same as before but with pre-chilling. Intermediate results: in all tests we got the same shelf life of the fish.

	Step 5: October 2011 We made the same tests as in Step 4 with the only difference that we didn't take fish pieces, but real redfish filets. Intermediate results: verification of the results in step 4. **Step 6**: November 2011 Same tests as in the preceding steps with the only difference that we took salmon filets instead of redfish filets. Intermediate results: in line with the previous results. **Step 7**: February 2012 Seventh test with salmon. CA Container and crates with modified atmosphere. **Step 8**: October 2012 Eighth test with whole redfish. CA Container and crates with modified atmosphere. Test failed, because of technical problems with the container. **Step 9**: It was planned to make a test with a whole container full of redfish from Iceland to Bremerhaven. This test was cancelled because of the lack of successful tests from November 2010 till October 2012. In July 2013 Deutsche See has decided to stop further tests.
Actors + roles	During our tests Deutsche See worked together with: • Max Rubner Institute, Hamburg for the examination of the fish; MRI Max Rubner-Institut www.mri.bund.de • Linde AG, Hamburg, for the packaging of the crates with special gas mixture Linde Gas Linde; www.linde-gas.de • Pneumatic Partners, Hamburg, manufacturer of the Container with changeable atmosphere technique. www.pneumaticpartners.de • MAP packaging solutions GmbH, manufacturer of the sealable crates MAP Packaging Solutions GmbH www.map-packaging-solutions.net • Unifeeder Norway: transport carrier of the container for the first test.
Critical Success Factors	The tests were influenced by the quality of the fish when the tests started.
Pitfalls	• The tests are not successful. Deutsche See has stopped all tests because of the dissatisfying results. • From an economic point of view, it did not make sense to continue the tests; as the longer shelf life with conservation of the same quality of the fish is not within reach.

Project/test results - Lessons learned	It is possible to achieve a longer shelf life of the fish. With the tested techniques (container with changed atmosphere and MAP packaging) Deutsche See has only achieved up to 2 days extra shelf life. This is too short to compensate for the extra transport time by ship of at least 5 days, compared to the current transport time. During our tests we made the experience, that the bacterial growth is not the most important factor to decide whether the fish is well for consumption or not. More important is the sensorial freshness of the fish. In some tests the bacterial growth was very low but the filets were of green colour, which is of course not acceptable. In some discussions with our suppliers we learned that the distrust to such new technologies is very large.