### Business challenge

To keep salmon stocks healthy, the Seafood Innovation Cluster wanted to help the aquaculture industry manage sea lice outbreaks more effectivelyand saw the potential of data science to find an answer.

### Transformation

The Cluster worked with IBM and several leading salmon farming companies to build AquaCloud, a predictive analytics platform that automatically gathers data on fish health and warns of outbreaks.

**Tanja Hoel**
**Director**
**The Seafood Innovation Cluster**

## Business benefits:

**70 percent**
**accuracy in predicting sea lice outbreaks, enabling rapid intervention**

**Automates**
**data collection and analysis, enabling daily monitoring of salmon health**

**Protects**
**aquaculture companies' sensitive data, making it safe for competitors to collaborate.**

# The Seafood Innovation Cluster

## Harnessing data science in the cloud to keep Norway's salmon populations healthy

The Seafood Innovation Cluster is a National Center of Expertise for the Norwegian seafood industry, with 90 members representing 15,000 highly skilled employees across the world. As a Norwegian Innovation Cluster, the organisation aims to increase growth in national and international markets through innovation and development.

*"The response from IBM was amazing, they were so positive about the idea and immediately looked into how they could best support this initiative. We talked to other AI companies as well, but IBM's response was the most impressive by far."*

Tanja Hoel

Director

Seafood Innovation Cluster

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## Keeping ecosystems in balance

In all industries that depend on natural resources, success depends on the ability to preserve the delicate balance between exploitation and conservation and the fishing sector has learned this lesson more sharply than any other. As global appetites for seafood continue to increase, it is vital to find ways to increase yields without depleting wild fish stocks through overfishing, disease or environmental change.

This is not just an ecological imperative, it is an economic necessity. Thousands of jobs in the fishing and aquaculture industries depend on sustainable fish stocks and when a fishery or farm is forced to reduce its production, it can devastate coastal communities.

In Norway, the salmon farming industry is an important contributor to the national economy. Norway is the world's largest producer of Atlantic salmon, 95 percent of which is exported. The health of this industry and its fish is a top priority for the Seafood Innovation Cluster, an industry-funded member organisation that aims to foster growth through technology.

Tanja Hoel, Director of the Seafood Innovation Cluster, explains: "It's our responsibility to find solutions to the biggest challenges facing the industry, while protecting Norway's sensitive marine ecosystems. At present, sea lice are the number-one threat to both salmon farms and wild salmon stocks."

Sea lice are parasites that are found naturally in marine waters, but which have reached unnaturally high concentrations in many of Norway's fjords and coastal waters due to intensive production of salmon and rainbow trout. For the Seafood Innovation Cluster, it is crucial to ensure that fish farming and sea lice do not impose an environmental threat to Norway's stocks of wild salmonids.

Commercial fish farming in open net cages leads to increased numbers of susceptible hosts, and represents a potential risk of increased reproduction and spread of parasites. This poses a threat to the affected fish farms and to wild fish populations living in the coastal areas.

> ***"The results of testing AquaCloud against historical data have been very impressive, the model is capable of predicting spikes in sea louse populations with great accuracy."***
>
> Tanja Hoel, Director, Seafood Innovation Cluster

The Norwegian salmon industry has experienced increasing difficulties with salmon lice, including increased resistance against the most important chemotherapeutants. Norwegian authorities have imposed severe regulations and further growth of salmon farming in Norway is restricted unless the levels of salmon lice are controlled.

"At a conservative estimate, the direct cost of sea lice management is at least USD 600 million and some experts put it at closer to USD 1 billion per year," says Tanja Hoel. "It is also a major inhibitor to industry growth. If farmers can't prove that they have lice populations under control, they are not allowed to expand their operations."

The industry realised that since its fish farmers operate in close proximity in the fjords, the problem can only be solved by working together, a novel situation for these highly competitive companies. The challenge for the Seafood Innovation Cluster was not only to solve the sea lice problem, but also to find a way to help rival farmers collaborate and share information while protecting their commercially sensitive data.

## Finding patterns

The Seafood Innovation Cluster knew it would need a technology partner to help it build a solution capable of collecting, anonymising and aggregating data from salmon farms across Norway, analysing the sea lice counts and presenting useful, actionable data back to farmers on a daily basis.

Tanja Hoel comments: "We spoke to the head of the Oslo Cancer Cluster about a project that they had worked on with IBM® Watson technology and we were intrigued and impressed by the results. We wanted to find out more about how new techniques like machine learning can help to combat sea lice and solve other fish health problems."

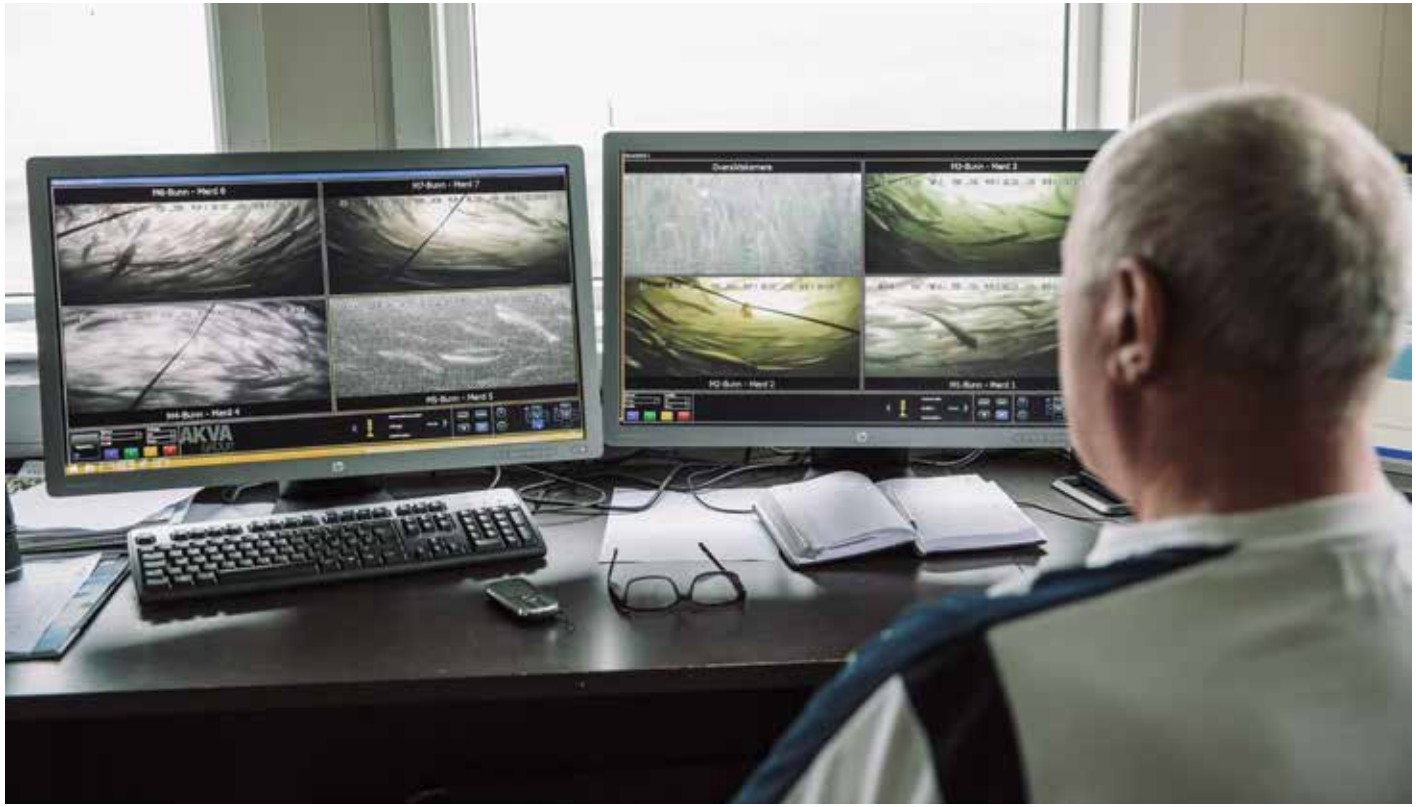
She adds: "The response from IBM was amazing, they were so positive about the idea and immediately looked into how they could best support this initiative. We talked to other Artificial Intelligence (AI) companies as well, but IBM's response was the most impressive by far."

IBM dedicated a team of data engineers, data scientists and cloud specialists to the project, while the Cluster persuaded seven of the leading Norwegian aquaculture companies to provide sea lice counts and other information from their salmon farms.

Together, the team built AquaCloud, a solution that automatically extracts data from the farmers' Mercatus and Fishtalk Enterprise resource planning (ERP) systems on a daily basis and combines it with open data sources provided by the Norwegian government and other sources.

The total volume of data includes over 945,000 data points daily, from more than 2,000 salmon enclosures. This data is loaded into a cloud data warehouse (IBM Db2 Warehouse on Cloud), which provides a carefully designed environment that keeps data from each of the farmers separate and only shares data that has been anonymised and aggregated.

"We knew from the beginning that it was critical for AquaCloud to make data capture seamless," says Tanja Hoel. "Performing regular lice counts is already a time-consuming and difficult job for the farmers, so we didn't want to add to their workload by asking them to submit data manually. IBM came up with a neat solution that integrates with their existing systems and extracts the information we need automatically.




"Security is also very important, because some of the data that the farmers provide is very commercially sensitive. IBM was able to show us how the built-in security features in Db2 Warehouse on Cloud keep this data safe, which helped the farmers gain trust in AquaCloud."

The IBM team used IBM Watson Studio to design a model that uses a random forest algorithm to predict the probability of a sea lice outbreak for each farmer. So far, the AquaCloud model has been 70 percent accurate over a two-week horizon, and the team expects the results to improve as more data becomes available and lice-counts become more accurate.

The results can then then be presented to each farmer via an IBM Cognos Analytics dashboard, giving them an estimate of the likelihood of an outbreak at each of their sites over the next two weeks. This should give farmers enough time to take countermeasures before the sea louse population explodes, for example by introducing cleaner-fish, or using other mechanical delousing techniques.

## Putting theory into practice

Tanja Hoel comments: “The results of testing AquaCloud against historical data have been very impressive, the model is capable of predicting spikes in sea louse populations with great accuracy. The next step is to take the solution out of the lab and verify the results in a field trial with some of our farmers. This is critical to gain the trust of the farm managers, so that they will be confident that the model provides a sound basis for decision-making.”

If the solution shows the same accuracy in the field, and is adopted by Norway’s salmon farmers, the impact on the industry could be significant. By preventing outbreaks, it could not only improve the health of farmed salmon populations, but also protect wild salmon stocks against disease. And by helping to keep sea lice numbers below the strict limits imposed by the Norwegian government, it could help companies avoid restrictions and enable them to grow their operations.

Tanja Hoel concludes: “Regardless of the success of the model itself, the AquaCloud project has already proved something very important. With the right technology and legal frameworks in place to protect their data, aquaculture companies can work together to achieve a common goal, without inhibiting their ability to compete in a fair market. It is a very positive sign for the future of the industry in Norway, and it might be an important lesson for other sectors that need to manage their ecological impact too.”

### Solution components

- IBM Cognos Analytics
- IBM Db2 Warehouse on Cloud
- IBM Watson™ Studio

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