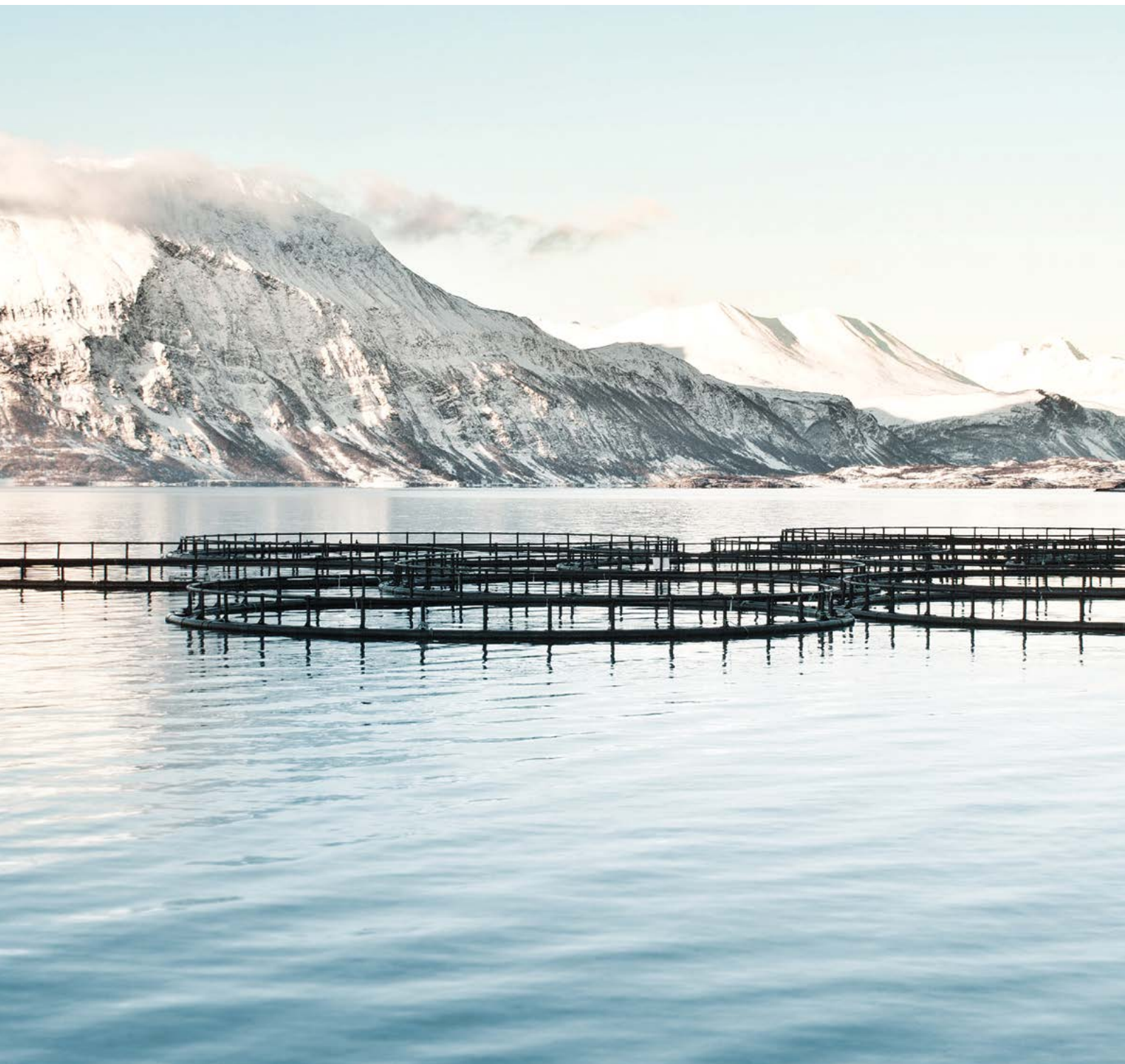


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WHITE PAPER

# Capitalizing on the boom in aquaculture by harnessing the power of technology and Industry 4.0



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# Executive summary

The salmon and trout farming industry has achieved spectacular growth over the last decade. Despite this success, it faces several challenges to continued growth, such as high operational costs and difficult environmental conditions. Using enterprise-wide process automation systems and the emerging Industry 4.0 technologies, companies in this sector could significantly improve their performance as they move towards a future where demand for their products looks set to increase substantially.



# 1.0 Challenges ahead for the salmon and trout farming industry

While progress in aquaculture has been spectacular during the last decade, this development has been in the making for the last 30 years, led by Norway which now accounts for roughly 60 percent of the market.

Norwegian salmon and trout farming started out as a cottage industry in the 1970s to supplement incomes in rural communities. Gradually, the industry grew in economic importance and, during the 1990s, it consolidated into a number of major national companies. And, according to EY's "Norwegian Aquaculture Analysis 2016" total revenue in this sector grew more than 200% since 2006.

Now, the industry faces the next stage of its progress, as well as a major challenge – how to become a global industry with world-class levels of productivity, service and product safety while dealing with rising operating costs, mainly driven by sea lice and disease.

The Food and Agriculture Organization of the United Nations (FAO) forecasts that worldwide consumption of fish will increase five-fold by 2050. Norway's annual aquaculture production of Atlantic salmon and trout is about 1.3 million metric tons, worth some €3.6 billion. If this were to increase in line with the FAO's expectations, aquaculture may eventually rival the country's oil industry in size.

Increasing the size of the sector substantially will require a significant leap in technology. A great productivity boost, using automation of the type seen in mainstream process industries, is needed if capacity is to increase several times over. Further productivity improvements, in excess of what is available today, will become possible over the coming years as new technologies are introduced.

Many sites today have a high degree of mechanization, with some large processing plants able to process more than 1,000 metric tons of product per day. But there is significant room for improvement.

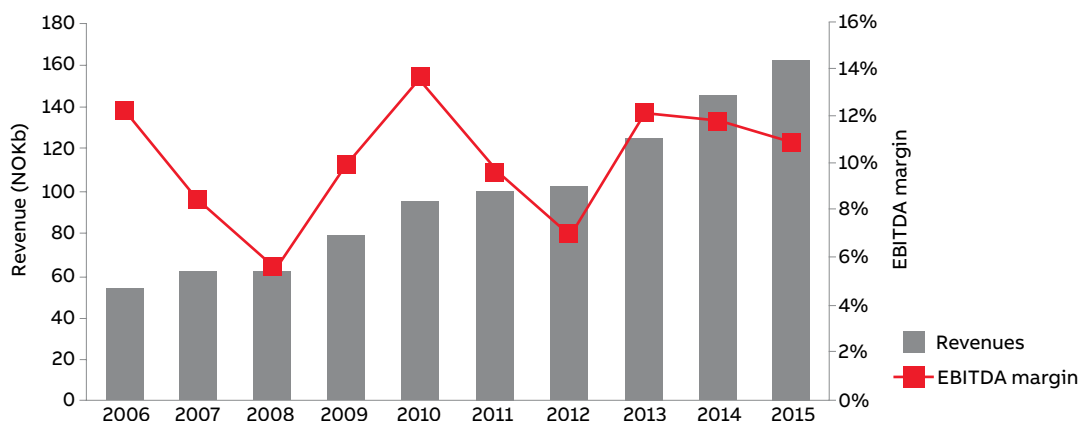


Figure 1. Norwegian aquaculture industry. Aggregated revenues 2006-2015. Source: EY Norwegian Aquaculture Analysis 2016©

### **Process automation and Industry 4.0**

While automation is used on an equipment level in the value chain, the greater benefits of automation have not yet been realized. In general, companies in the food and beverage industry tend to be less automated than other industries, such as electronics or automotive. This is a significant drawback, at a time when digitization is moving at a rapid pace. Companies that fail to keep up stand the risk of losing out to more agile competitors that take advantage of the opportunities the new technology offers.

A number of technologies that have sprung from the growth of the Internet are now making their way into industrial applications. Collectively known as Industry 4.0, these include the Internet of Things (IoT), cloud computing, big data, cyber security and sensors, as well as automation software, simulation and robots. Internet traffic is growing at 23% per year, with the majority of the increase originated by non-PC devices. With cloud storage offerings from several major providers, storing massive amounts of data has become affordable. In industrial applications, this will allow more extensive analysis of product and system behavior than ever before.

These changes will affect all business sectors. As the technology develops, new business opportunities will emerge.

Already, it is possible to build a virtual process line to use for design and test before actual set-up. During operation, the virtual process can be used to predict and optimize performance and to integrate processes across the value chain.

### **Optimizing the process**

With automation, in combination with the new technologies, processes can be integrated vertically through the whole organization, from

the production of feed to the saleable salmon or trout product. All data about processes, efficiency, quality and operations planning are available in real time in an integrated network. Key performance indicators (KPIs) are collected at every stage to improve performance. Horizontal integration can extend to partners in the distribution chain, with tracking, tracing, planning and execution. This integrates equipment, people, control and business systems, and synchronizes production processes and logistics operations, while offering plant wide transparency and full traceability.

This level of control leads to improved plant utilization, better food safety, healthier and faster-growing fish and more efficient use of the feed. Productivity can be improved by a few percentage points at every stage of the process. Put together, such gains add up to significant improvement to productivity and to bottom-line results.

Looking at individual processes, a process automation system could:

- Maintain close control of water quality in the fresh water stage
- Provide safe and healthy feed for the fish
- Help keep the fish safe and healthy in the pens
- Assist in transporting the fish efficiently, safely and economically from the pens to the processing plant
- Provide efficient, hygienic processing
- Ensure food safety standards in processing, packaging and distribution are met

By controlling all relevant parameters in every stage of the process and following up on KPIs, the complex process of farming salmon and trout can be optimized. Each stage works towards providing the best value for the process as a whole.

## 2.0 Background

While the precise growth in aquaculture varies by source (depending on a range of factors including species covered), they all agree that farmed fish is outpacing wild fish for human consumption. For example, in Figure 2 the FAO reported that aquaculture output worldwide grew from about 10 million metric tons per year in 1990 to about 175 million metric tons 2010. In the meanwhile, catches of wild fish remained fairly static during the same period, at around 90 million metric tons per year globally.

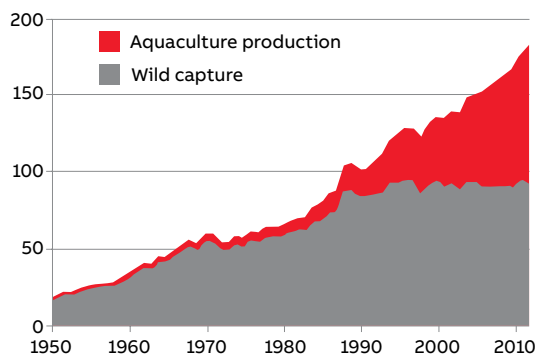


Figure 2. Global harvest of aquatic organisms in million tonnes, 1950-2010, as reported by the FAO.

Marine Harvest's "Salmon Farming Industry Handbook 2017" also shows a high growth trend which is expected to continue for the foreseeable future.

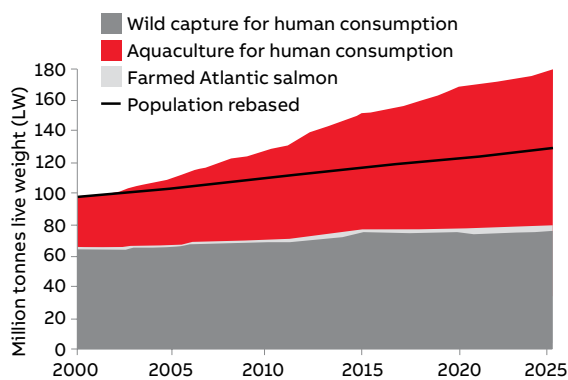


Figure 3. Source: Marine Harvest Salmon Farming Industry Handbook 2017©

Due to a number of biological and geographical factors, salmon farming can only take place in a few places around the world. The map in figure 4 shows the main areas.

Today, only 2% of the human diet comes from seafood, but in some areas it is as high as 70%, indicating that overall consumption could be significantly increased to support growing populations. Agricultural production is nearing capacity and stocks of wild fish are under severe pressure from overfishing, so fish farming looks set to become increasingly important over the coming years. Capture of wild fish can only meet two-thirds of the current demand for fish, so any future increase in demand due to population growth will have to be met by aquaculture.

Fish farming started in China thousands of years ago. It still continues all over the world in its original form, in ponds with herbivore or omnivore species without any particular requirements regarding their surroundings or the quality of the water. The farming of salmonoid species is a much more recent and far more complex practice. Salmon and trout have very exacting requirements and farming them needs significant investment, but the finished product is a more sought-after food product than traditionally grown species and commands a higher price.

**Detta är endast ett utdrag. Kontakta mig om du vill läsa dokumentet i sin helhet.**

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