



PROJECT TITLE | **The IoT Platform for Smart Oyster Farming**

COMPANY NAME | **The University of Tokyo**

## Smart Fisheries with the Latest Technology Link Etajima Together

Hiroshima has the highest oyster production in Japan. In oyster farming, collecting oyster larvae is essential. However, the rate of larvae collection has been decreasing, destabilizing the industry. To solve this situation, which is severe enough to threaten the health of the local economy, a project was established to collect detailed environmental data about the state of the oyster hatchery waters with various IoT technologies. With the aid of AI analysis and machine learning, they aim to establish a new smart oyster farming method that is supported by hard data instead of the traditional fisherman's instinct.

Oyster rafts of Hirata Suisan



### Saving Oysters Farmers with IoT

Etajima is a beautiful city located on the islands that line Hiroshima Bay. In recent years it has made headlines for its beautiful scenic views, festivals, and immigration policies. However, it is oysters that are the main economic driving force in Etajima. The prefecture of Hiroshima produces more than 95000 tons a year, with Etajima in the lead and the city of Kure as a close second. Both of these cities combined make up 30% of Japan's total oyster production. The view of numerous oyster culturing rafts swaying in the waves is a typical sight in Hiroshima.

However, this once ever present scenery is starting to change. Oyster farming requires farmers to collect the fertilized egg larvae from adult oysters and then transfer them to scallop shells where they can grow. Despite this dedication, spat collection is very unstable and hit an all time low in 2014, which had a huge effect on the industry as a whole. With collection rates continuously dropping, farmers had to turn to other districts to purchase spat, and incurred a loss of more than 2.5 billion yen. Furthermore, such conditions are leading to a loss of farmers, many of whom are elderly, and cannot keep up with this instability. In the seven years between 2006 to 2013, 26.6% of farms have closed their doors. The number of oyster farmers is still decreasing.

To help reverse these statistics, a team has been put together to conduct several field tests. This project's group consists of Akihiro Nakao, a professor at the Graduate School of Interdisciplinary Information Studies at Tokyo University; Sharp; NTT docomo; Chugoku Electric Power; Luce Search; Sessile Research Corporation; Etajima City and the fisheries cooperative of Nomi. The Hiroshima Prefectural Technology Research Institute will also help with testing, which will be conducted at Hirata Suisan.

To ensure a successful spat collection, farmers and researchers need to recognize the environmental conditions for spawning and be ready for spawning when it occurs, all while predicting tidal currents and where they will carry the larvae. Another factor to take into consideration is the food source, plankton, and the duration of time that the larvae will need to rely on it. Until now this method has mainly been conducted by instinct, generations of knowhow passed down to each new successor. However, this project is introducing new technology, such as drone cameras, to aid in film capture and the prediction of fertilization areas. In addition to this, ICT buoys and a solar sensor node will be released to survey and collect data about water temperature and salinity. These changes will make for a much more efficient process. The project will use LPWA (low power, wide area) wireless technology and then use AI and machine learning to analyze data and set up farming based on the new information. Further applications will be utilized to help with real time information sharing to aid in the process of cultivating new oysters.

### A Failed First Attempt Bears New Fruit

The conception of this product was initially a total coincidence. Professor Nakao, who had been participating in another project at the time, just happened to be introduced to Nishiki Kakuta from Sharp. When Nakao made an offhand comment about his underwater sensor, Kakuta mentioned that he was from Etajima. For Professor Nakao, it was also a place filled with childhood memories, where he spent the summer with his grandfather and exploring the island. From there, an idea was born. Kakuta, who spent his childhood on the island, had many connections there, one of those being the fisheries cooperative of Nomi. As discussions progressed, the pair made their first proposal to Hiroshima Sandbox. However, their first attempt ended in failure. Professor Nakao reflected on that time saying, "At that time we thought that if we just had the technology, then it was possible to fix anything. We couldn't really grasp the entire situation surrounding Etajima and its oyster farms. That's when we realized that it wasn't technology first, but the issue itself. From there we've invested more time learning about the process of farming." After some research, the name Yasushi Hirata, from Hirata Suisan, popped up. Hirata used to be a researcher working for a fisheries research lab before starting his own oyster farming business in his hometown of Etajima. After hearing the proposal he soon agreed, and offered up his oyster rafts as a test site location. With his support the group was able to pass their second project proposal.

### Technology vs. Nature

Even after gaining approval, not everything was smooth sailing. The sensors that had been developed by Professor Nakao got washed away in a storm together with the broken frame of the raft. The sensor was able to be retrieved later on, but the team realized the harsh conditions that the smart technology would have to face in order to be successful.

However, other members of the group stepped up to help solve these problems. When they figured out how to apply the LoRa (long range, low power, wide area network), Yoshihiro Shimoie from Fisheries Cooperative of Nomi took it upon himself to drive around the bay for hours and hours carrying a machine. After these efforts the whole town offered their support. At first walking on the rafts was a difficult challenge, but "not anymore," says the professor. Even though Nakao lives in Tokyo and is separated from much of the team, they still have a strong connection and are in constant contact as to what is happening, building an unbreakable trust.

### Team Work—the Combined Power of Hiroshima Sandbox

There are many theories about why the rate of larvae collecting is decreasing. One example is that rain and dam discharge are having a negative impact on the amount of phytoplankton and the salinity of the water. "We conduct field tests to make sure if a hypothesis is true. There are problems that Hiroshima Sandbox can solve, problems that we can't and Etajima can't. We plan to take our first steps out of Etajima and make our technology available to the whole oyster farming industry in Hiroshima, improving the future of a critical Hiroshima industry." They are planning to collaborate with FEIS, Hiroshima Pref. Fisheries & Marine Technology Center, Hiroshima City Agriculture, Forestry and Fisheries Promotion Center as well as Etajima city and fisheries cooperatives.



- The University of Tokyo / Nakao
- Sharp Corporation / Ishitani, Kadota
- Etajima City, Hiroshima / Tomarino, Tomarino
- Fisheries Cooperative of Nomi / Yanagawa, Shimoie
- Hirata Suisan / Hirata
- Sessile Research Corporation / Yamashita, Kamiya, Hayashi
- The Chugoku Electric Power Company, Incorporated / Yanagawa, Nakanura, Hayashi
- Luce Search Co., Ltd. / Watanabe, Natori
- NTT DOCOMO, INC. / Kanemoto, Nakashima, Matsubara
- Hiroshima Pref. Fisheries & Marine Technology Center / Yanagawa
- General Affairs Bureau of Hiroshima Prefecture / Terayama