



# aquaManager

## IMPROVE PRODUCTION EFFICIENCY AND MANAGEMENT IN AQUACULTURE OPERATIONS USING ICT AND DATA MINING TECHNOLOGIES

Kostas Seferis

Business Development Manager

Integrated Information Systems S.A.

aquaManager



NWFCC 2017

# Who we are

- ✕ i2S - aquaManager Team
- ✕ More than 20 years of experience in ICT for aquaculture
- ✕ Global presence – multiple species
- ✕ Intensive R&D, we consider innovation as a key factor for success
- ✕ CDFW is using aquaManager

Our mission: have a positive impact on the sector and help aquaculture to transform from **experienced-based to knowledge-based**. We use ICT to help companies to **improve performance** and produce in a **sustainable, environmental friendly** way

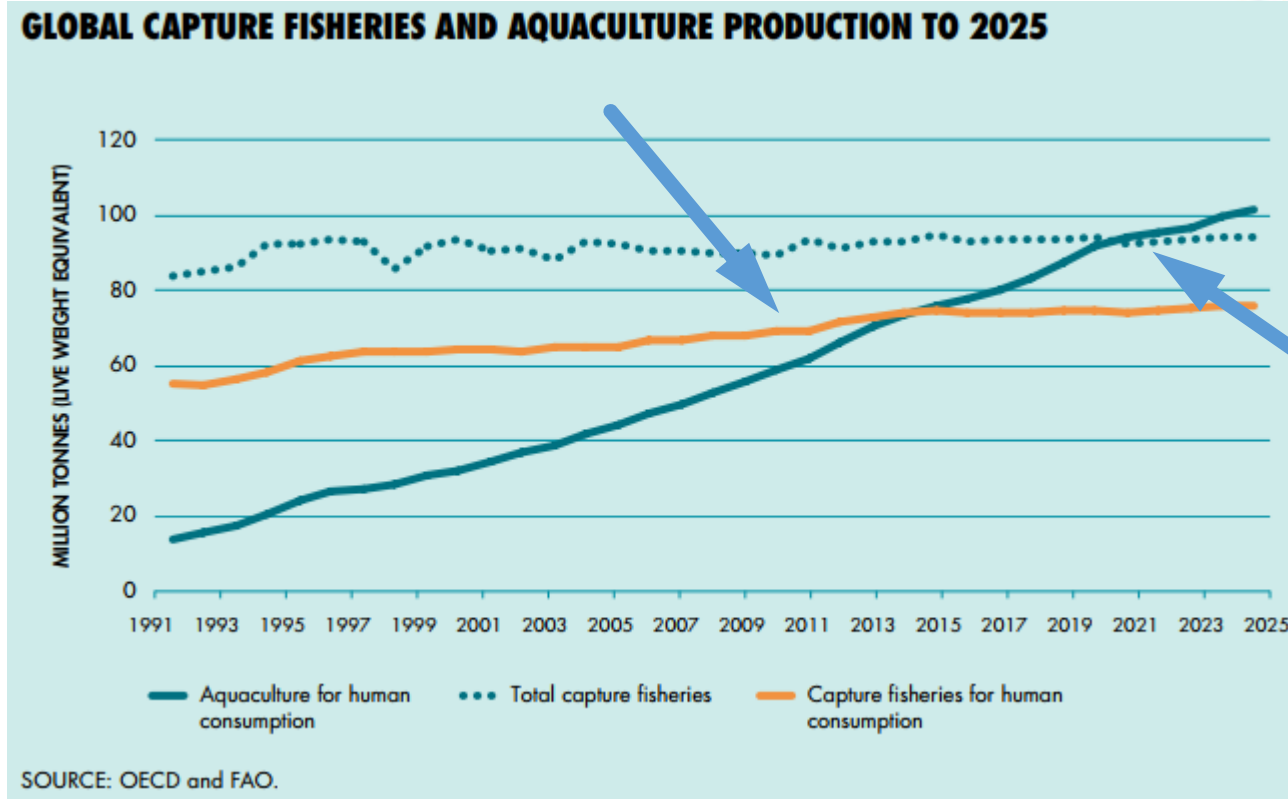
# Presentation Outline

- Aquaculture's present and future
- Production Challenges
- ICT and Data mining
  - Benefits
  - Examples
  - Business cases
- Additional benefits
- Conclusion



# Some key facts about aquaculture

- 2014 was the first year that aquaculture surpassed capture fisheries
- Is the fastest growing animal food producing sector *that* now accounts for nearly 50 percent of the world's fish that is used for food
- There will be an increasing demand for fish protein to sustainably support and feed a projected population of 9,6 billion people by 2050.
- It has a huge social and economic potential



# The Challenge

- › Production is **extremely sensitive** to feed, conversion, health and bio-security
- › In Grow Out, Feed and health represent **70% of OPEX**
- › Making **right decisions** can make the difference between success and failure
- › **Accurate scheduling** is very important
- › **Production people need to respond** to challenges in **real time**
- › They need to know what is happening, why it's happening, as it happens

# What a successful company or organization must do - 1

- ✎ Check everyday if the **feeding** and the management of fish in general is done in a proper way
- ✎ **Evaluate performance** of all units or batches – compare this performance to the expected one
- ✎ Reduce costs through better **planning**
- ✎ **Compare** actual **growth, mortality, cost** to the budget
- ✎ **Identify problems** immediately as soon as they appear





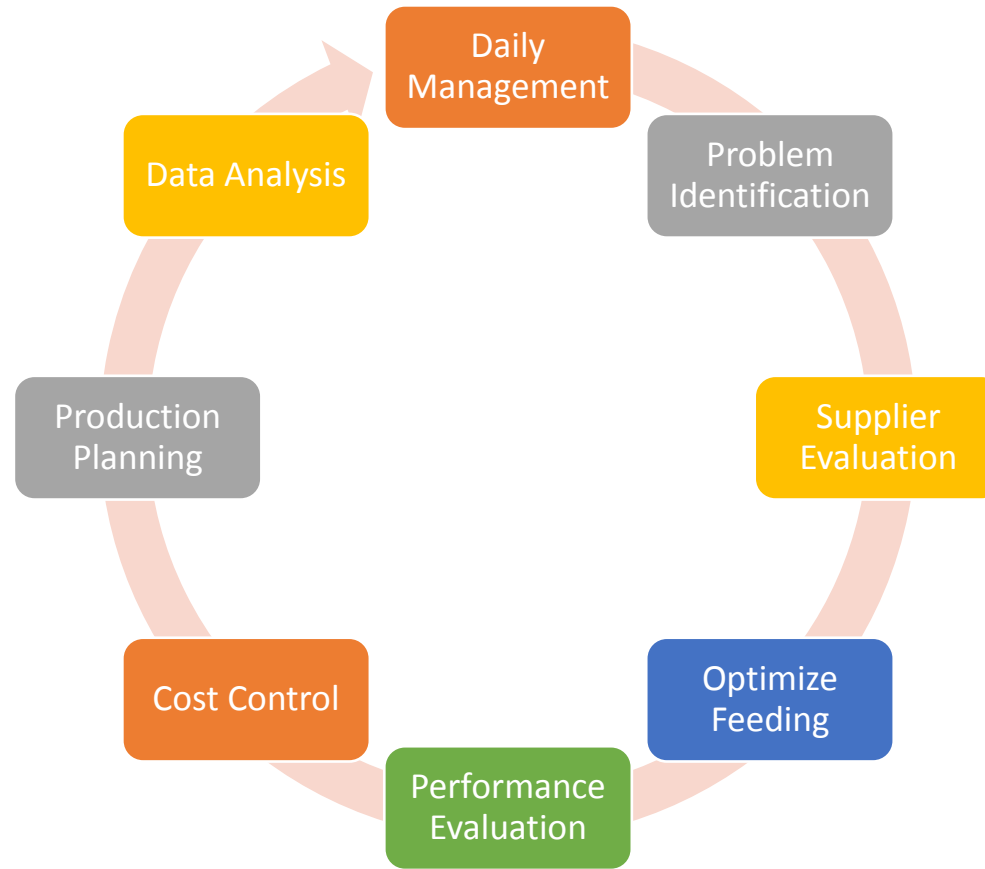
# What a successful company or organization must do - 2

- ✎ **Support** management for **decision making**
- ✎ **Evaluate** feed types, feed suppliers and feeding **policies**
- ✎ Ensure production information is collected - corrected
- ✎ Make best use of **available resources**
- ✎ **Exploit** available **data** to **improve production**
- ✎ And many more...



# The Challenge

Sounds like a lot of work!





# The Challenge

**Can someone do this without good support from ICT?**

- ✕ **Very difficult** to control production or cost drivers
- ✕ **No timely identification** of production issues or trends
- ✕ **Difficult to evaluate** feed and fry suppliers
- ✕ Purchasing policies based on **aggregated means**
- ✕ **Production planning** based on **rough estimations**
- ✕ **Higher management cost**
- ✕ **Mistakes**
- ✕ **No support** for decision-making



# ICT and Data Mining Benefits

- Improved quality
- Less mortalities and problems
- **Lower production costs, improved profitability**
- **Improved operational efficiency**
- **Management support** for decision-making
- Efficient and effective **management** of equipment and human resources
- Production at the **right time**, with the **right size**
- Improved **product quality**
- **Supplier evaluation**
- **Optimization of stock levels and purchase policies**

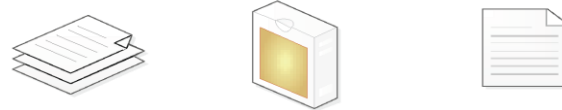


# Integrated model of the decision-making process

*Level III (top-tier) – The interface of the presentation layer*

*Decision Support System  
Make a decision by Decision Makers*

*Generating Models and Decision Opportunities*



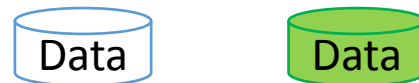
*Level II (middle-tier) – model management or analysis layer*

*Data Mining  
Tools*

**Organizational  
Learning**

*Level I (bottom-tier) – data management*

**Private Data Sources**



**Structured**

**Public Data Sources**



**Unstructured Workstation Servers**

# Data mining Benefits / 1

- ✕ Transform data into **knowledge**.
- ✕ Accurate view of the **life to date** fish behavior.
- ✕ Better track of the **living inventory**  
based on the analysis of all environmental and biological data.
- ✕ **Substantial improvement** of the **growth and feeding models**,  
which has great impact on predictions, business plans efficiency etc.
- ✕ **Evaluation of genetic improvement projects**

# Data mining benefits /2

- Make **accurate estimations** of the **growth** of the fish and the **result** of the production every day.
- **Minimize uncertainty** and moreover contribute to more precise **production and financial plans**.
- Improve the **quality** and **validity** of the collected data through **fraud detection** and **identification** of false data (outliers)



**Let's get more practical....**

# BlueMiner Platform

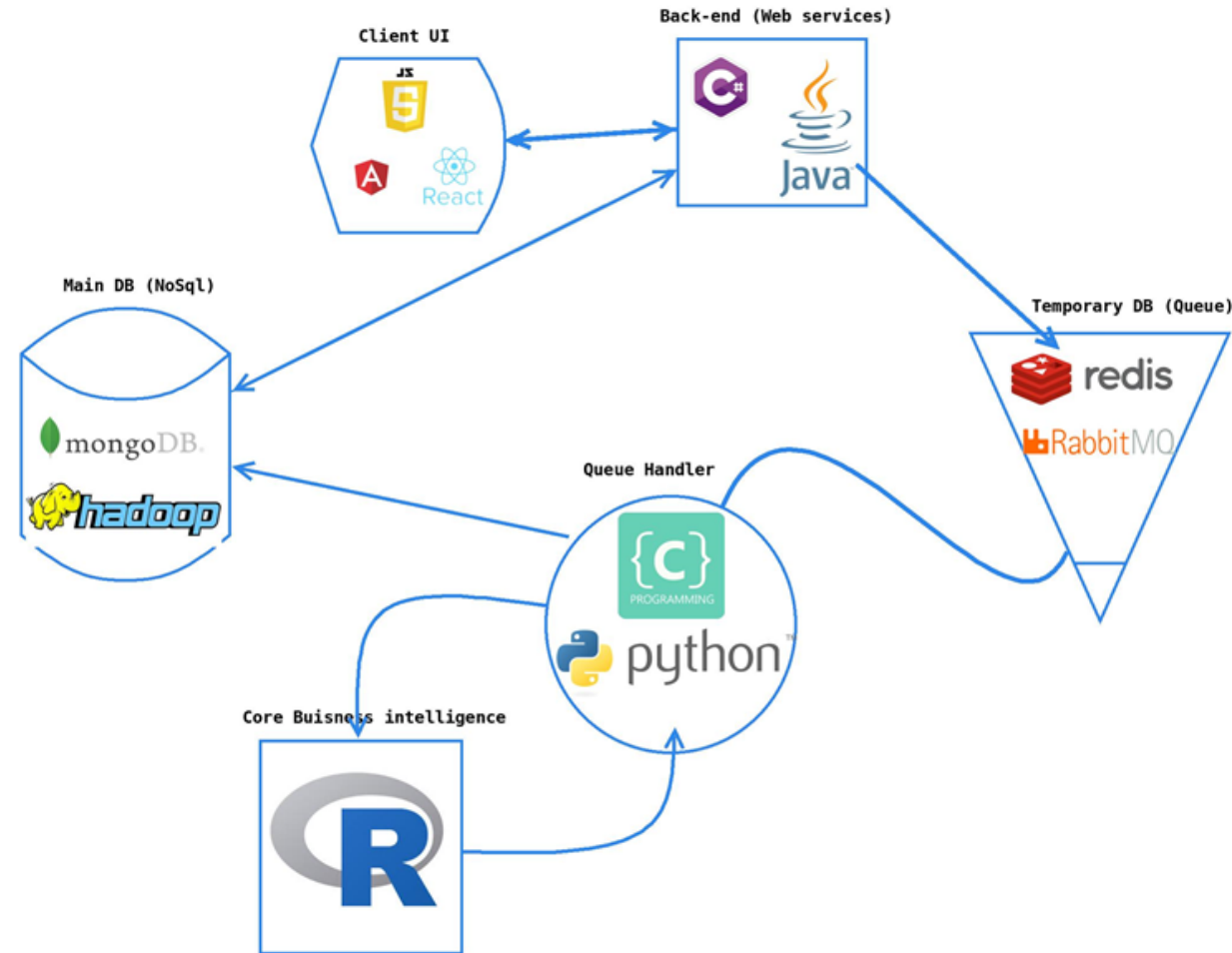


- Management of very **large datasets** (save, filter, merge, evaluate)
- Any number of numeric and categorical parameters can be used
- **Descriptive Statistics**
- Data Mining and **Machine Learning Models**
- Predictive Statistics
- APIs

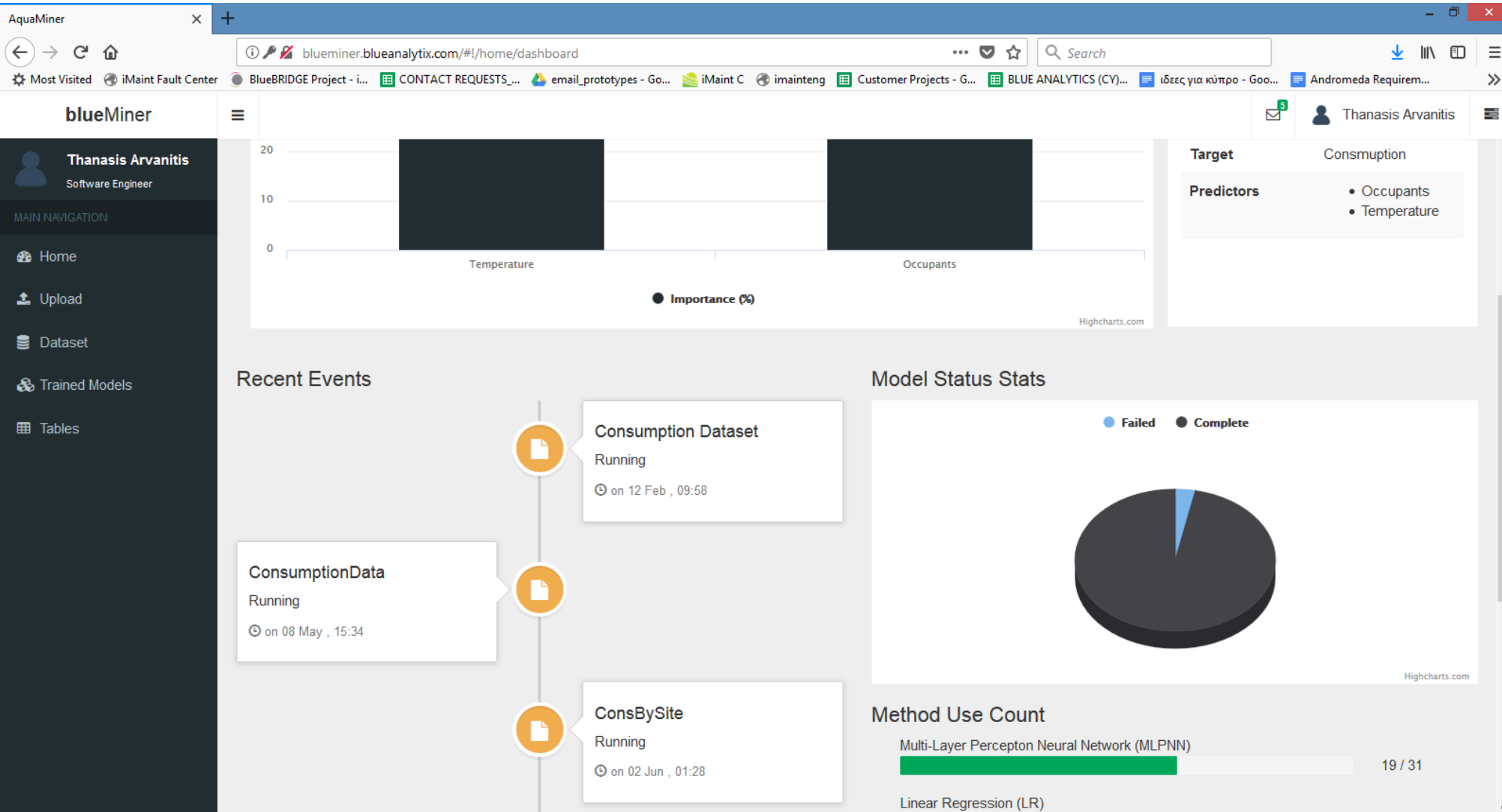


# Architecture

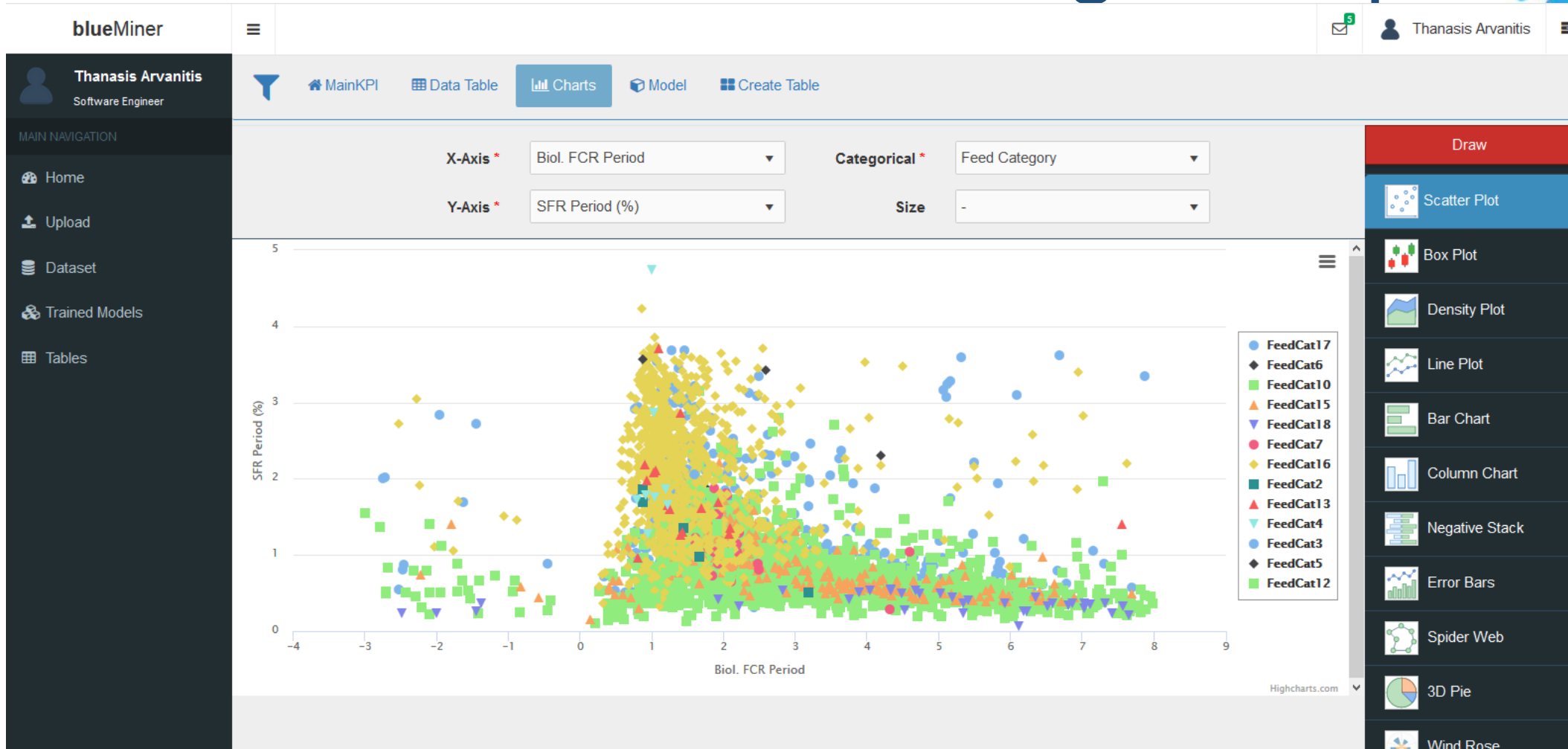
- State-of-the art technologies for data management and analytics
- Scalable
- Cloud solution, supported by powerful servers
- R is used for data mining and machine learning



## Some screenshots



# FCR vs Feeding scatterplot






# Model Building

A model has 3 components:

- Target
- Predictors
- Method

 **Model Options**  
 Select model options

---

**Designation**

**Target**

**Predictors**  

×  ×

**Method**

**Folds**

**Test Range**

Linear Regression (LR)

Random Forest (RF)

Support Vector Machines (SVM)

Gradient Boosting Model (GBM)

Generalized Additive Model (GAM)

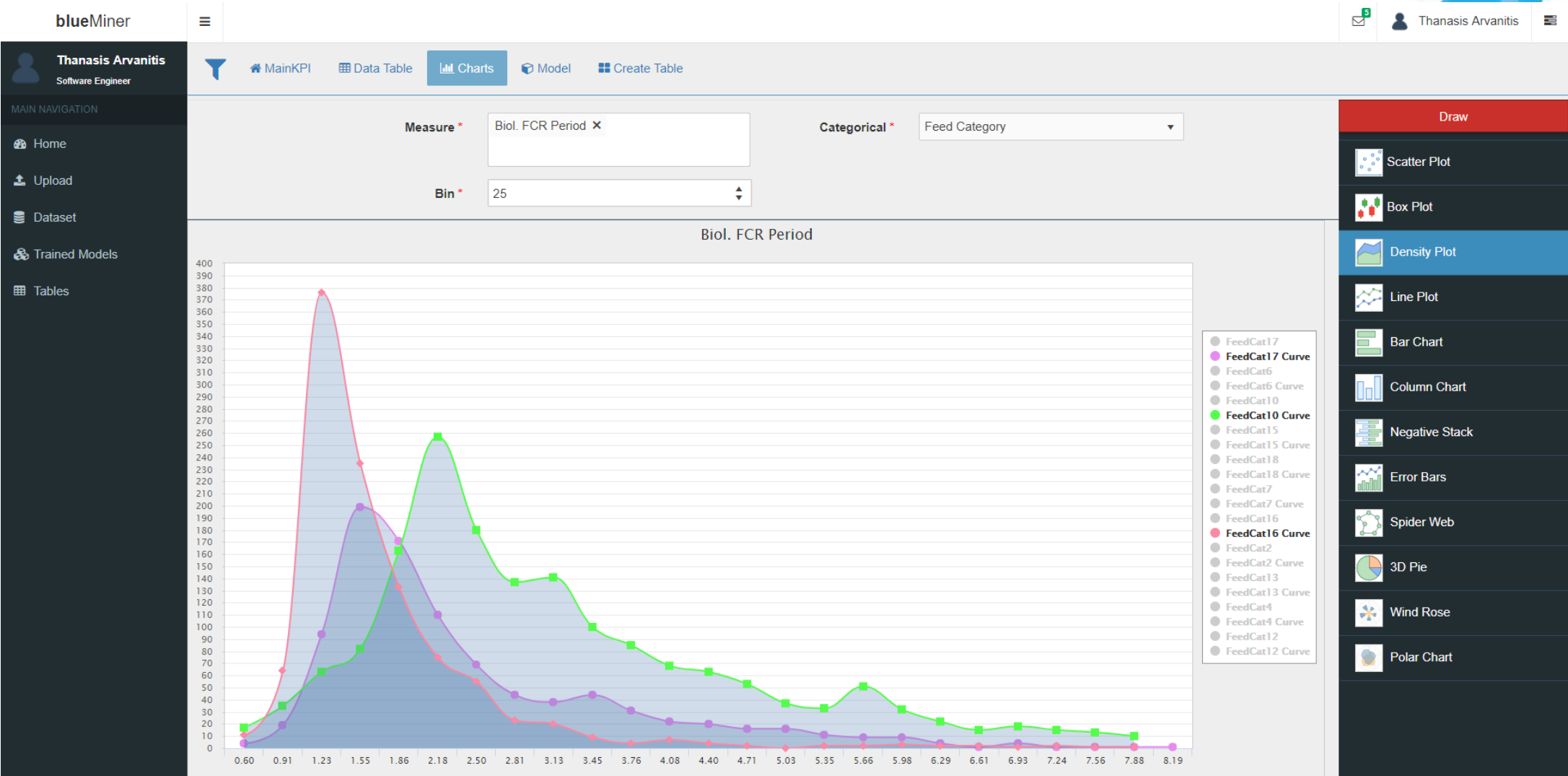
Generalized Linear Model (GLM)

Multivariate Adaptive Regression Spline(MARS)

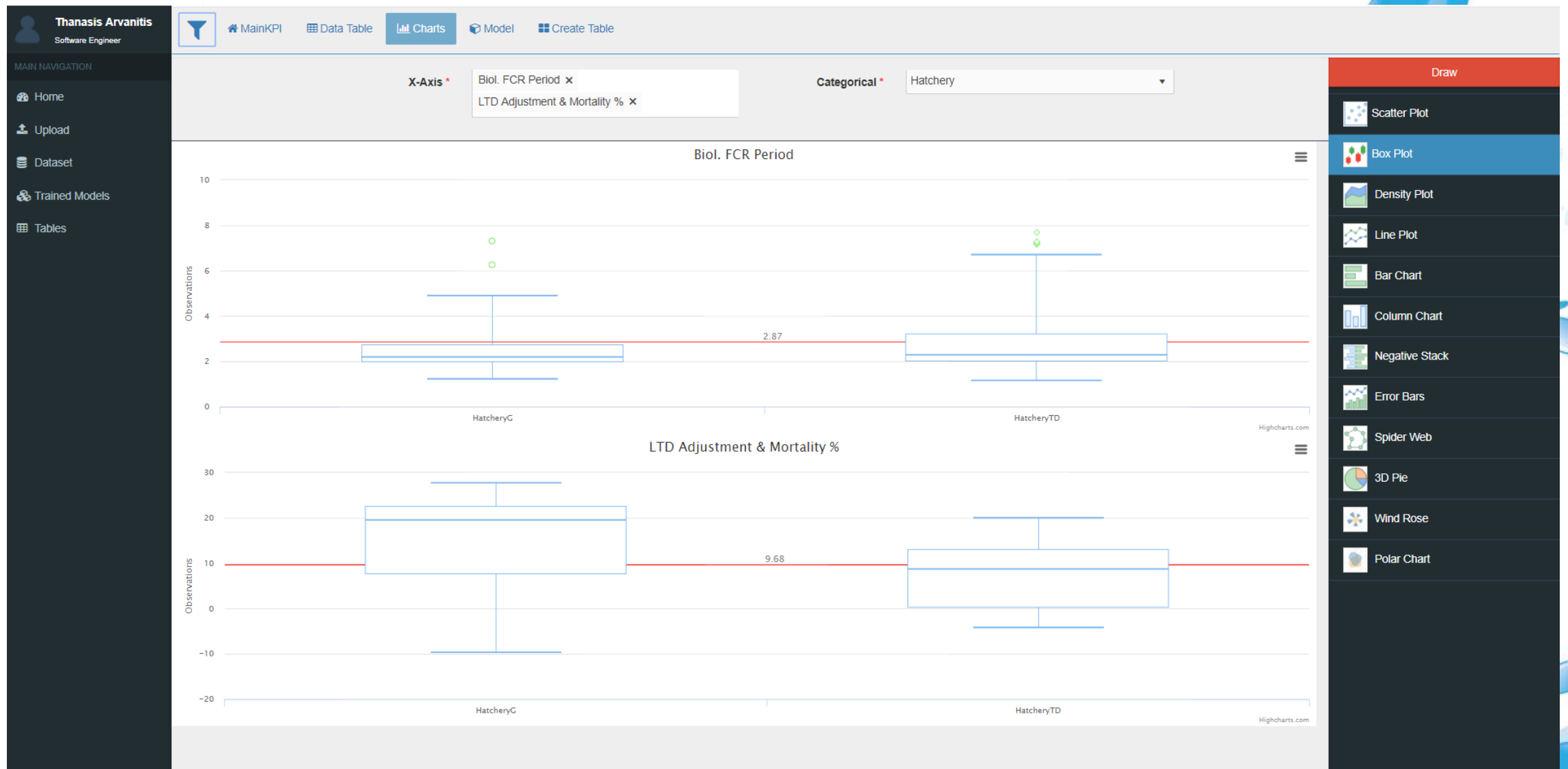
Classification And Regression Tree(CART)

Multi-Layer Perceptron Neural Network (MLPNN)

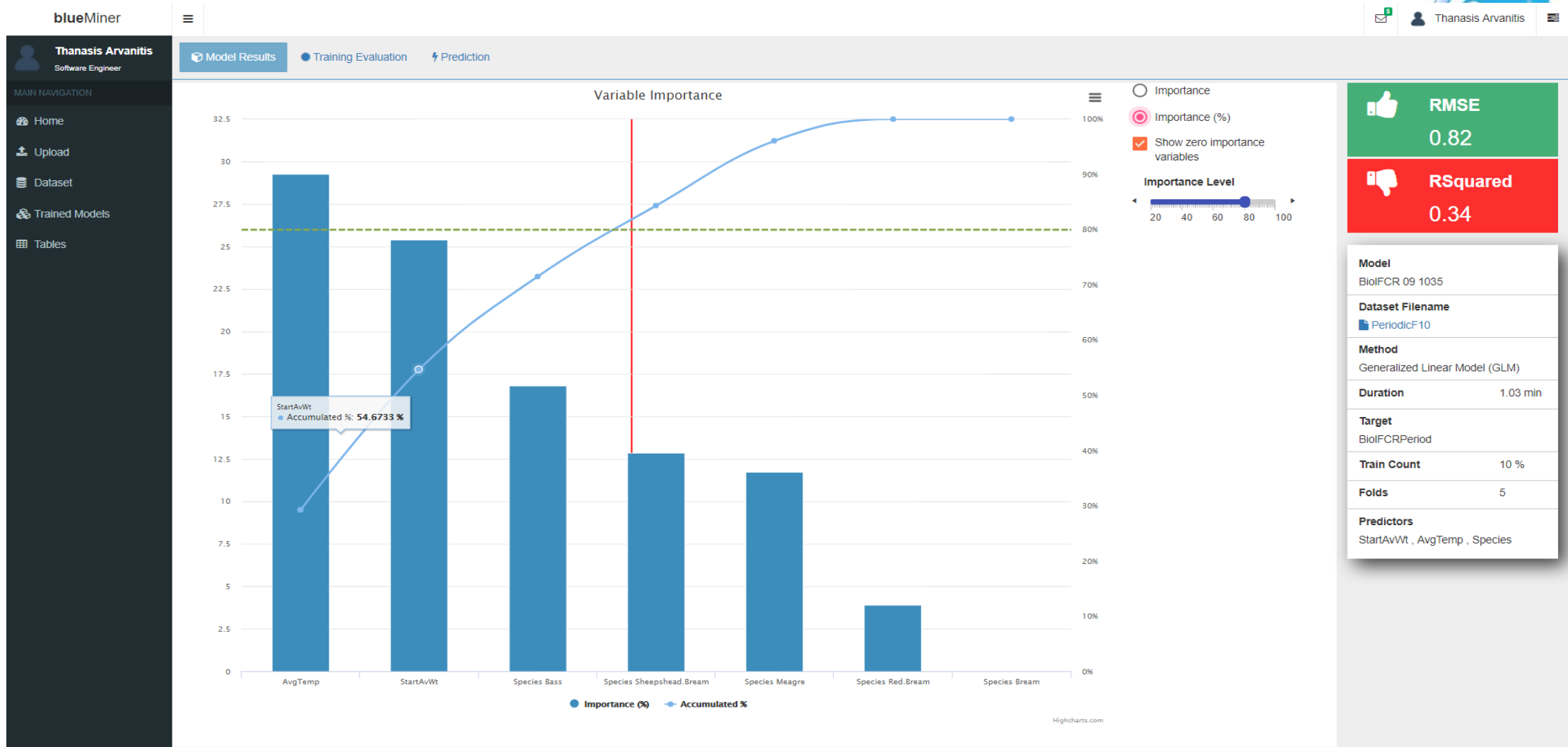
# FCR vs Feed Density Plot



# aquaManager FCR and Mortality by Hatchery Box Plot



# Machine Learning Model, identification of most significant parameters



# Business Cases

# Optimized feeding And Growth Models

## Company

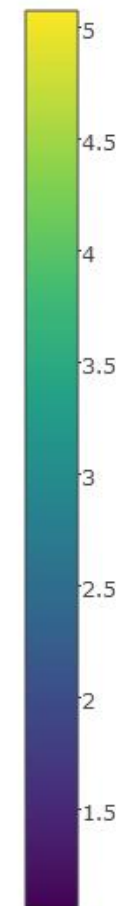
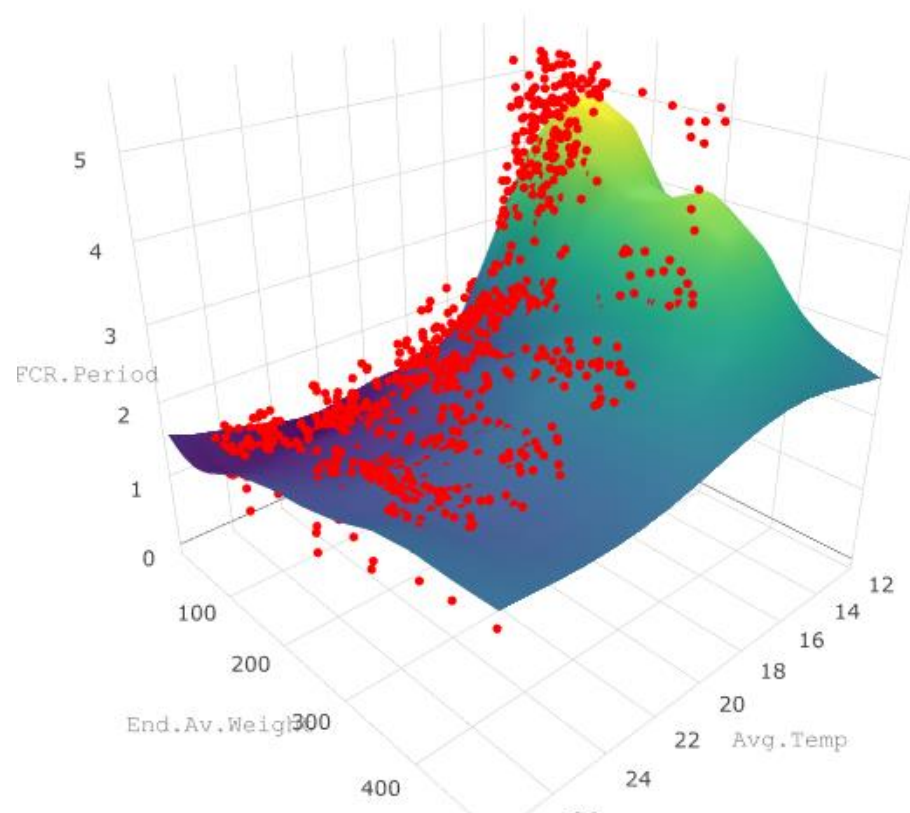
Open Sea, 5000 tons / year

## Achievement

Development of new, optimized  
Feeding and Growth Models

## Improvement

Reduction of feed cost by 6,8 %





# Understanding and improving performance

## Company

Open Sea, 12500 tons / year

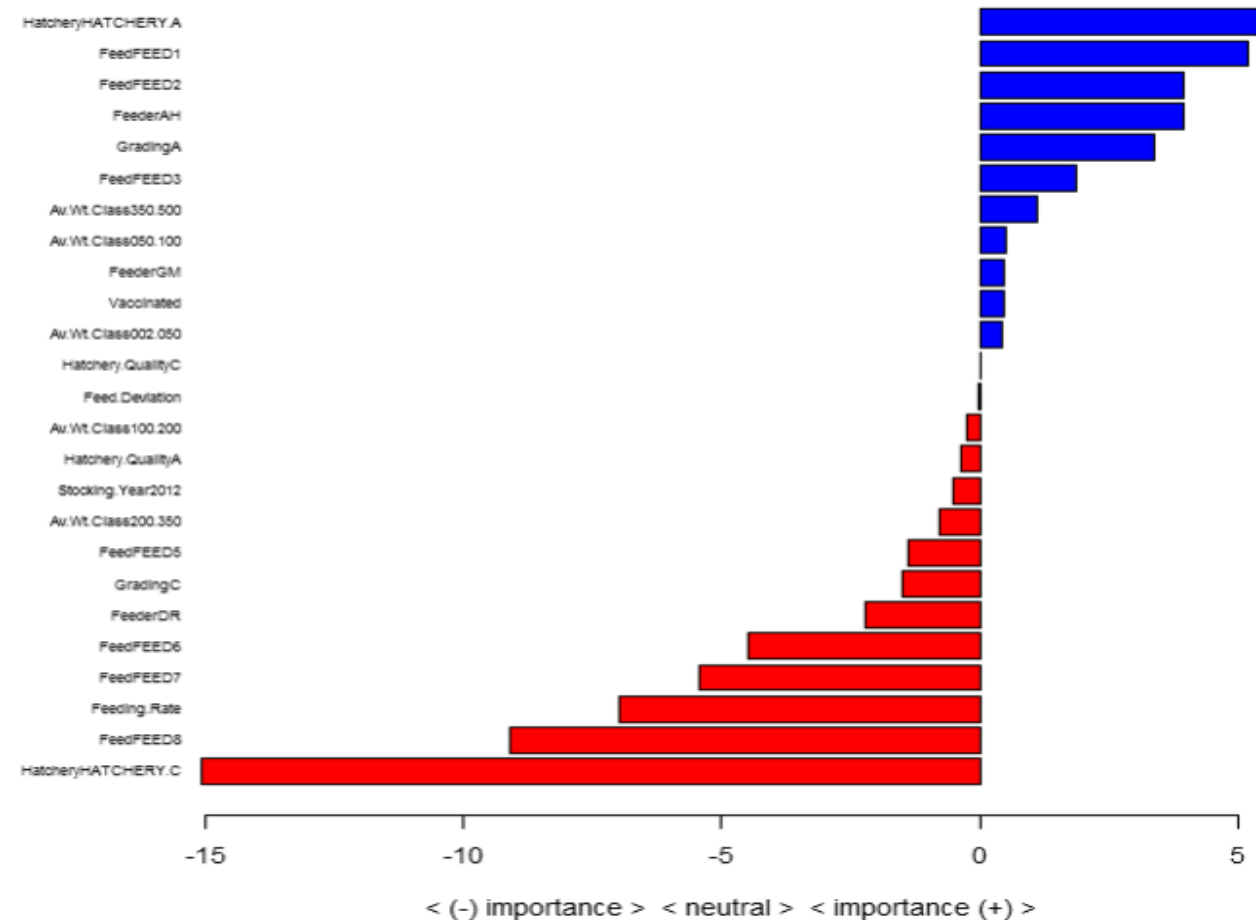
## Achievement

Understanding and predicting the impact of various parameters on the fish performance

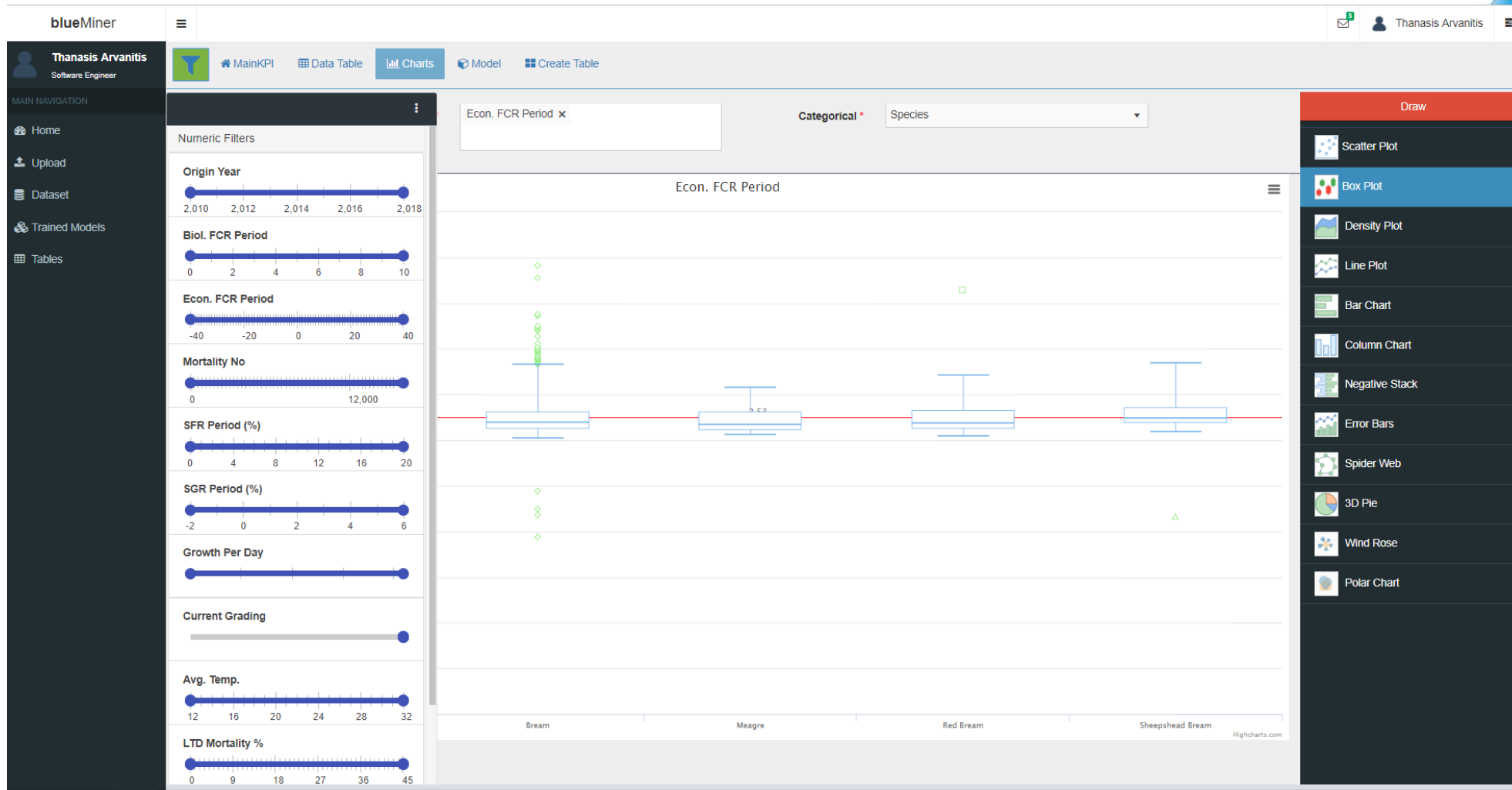
## Improvement

Selection of best feed suppliers, fry suppliers and optimization of fish management practices. Reduction of mortalities by 8,4% and cost by 6,2%

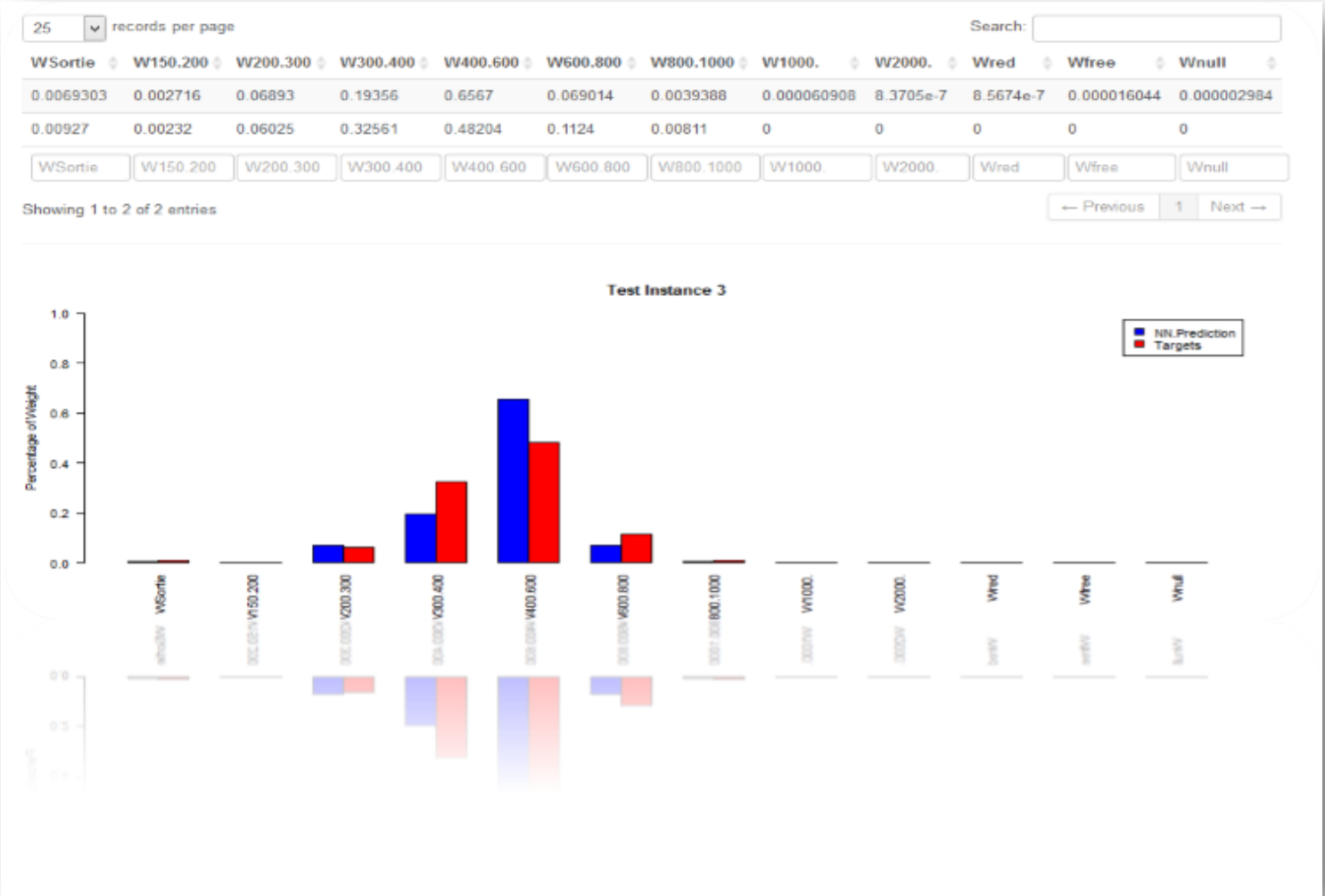
Variable Importance using GLM model



# Data Validity



# Prediction of harvest distribution



# Fish number and avg. weight estimation

## Company

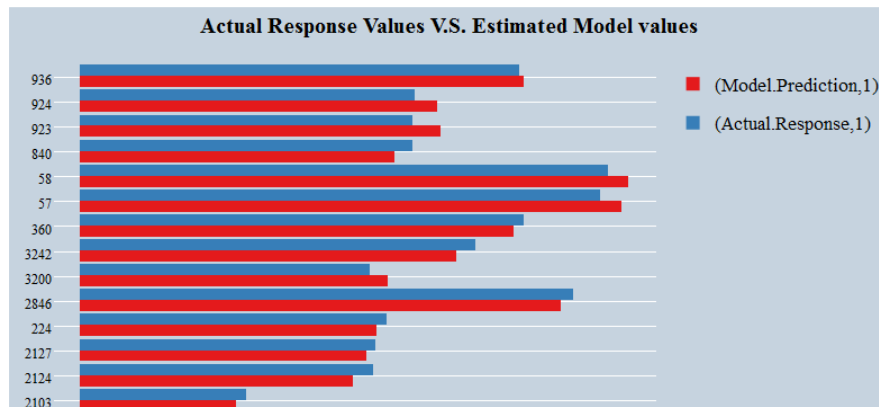
Open Sea, 2500 tons / year

## Achievement

Automatic identification of fish populations with performance problem or populations where fish are missing, using data between samplings and machine learning models

## Improvement

Optimization of feeding based on the actual biomass. Reduction of feed cost by 7,3% in a period of one year.



# Other Data Mining Benefits

# Cost Analysis

**First step to reduce costs?**



**Know the cost and the reasons for high cost!**

- 🔍 Do you know the cost of every unit, batch?
- 🔍 Do you know the profitability of every harvest?
- 🔍 Are you able to make an in-depth audit of the current expenditure?



# Better Production Planning

## Company

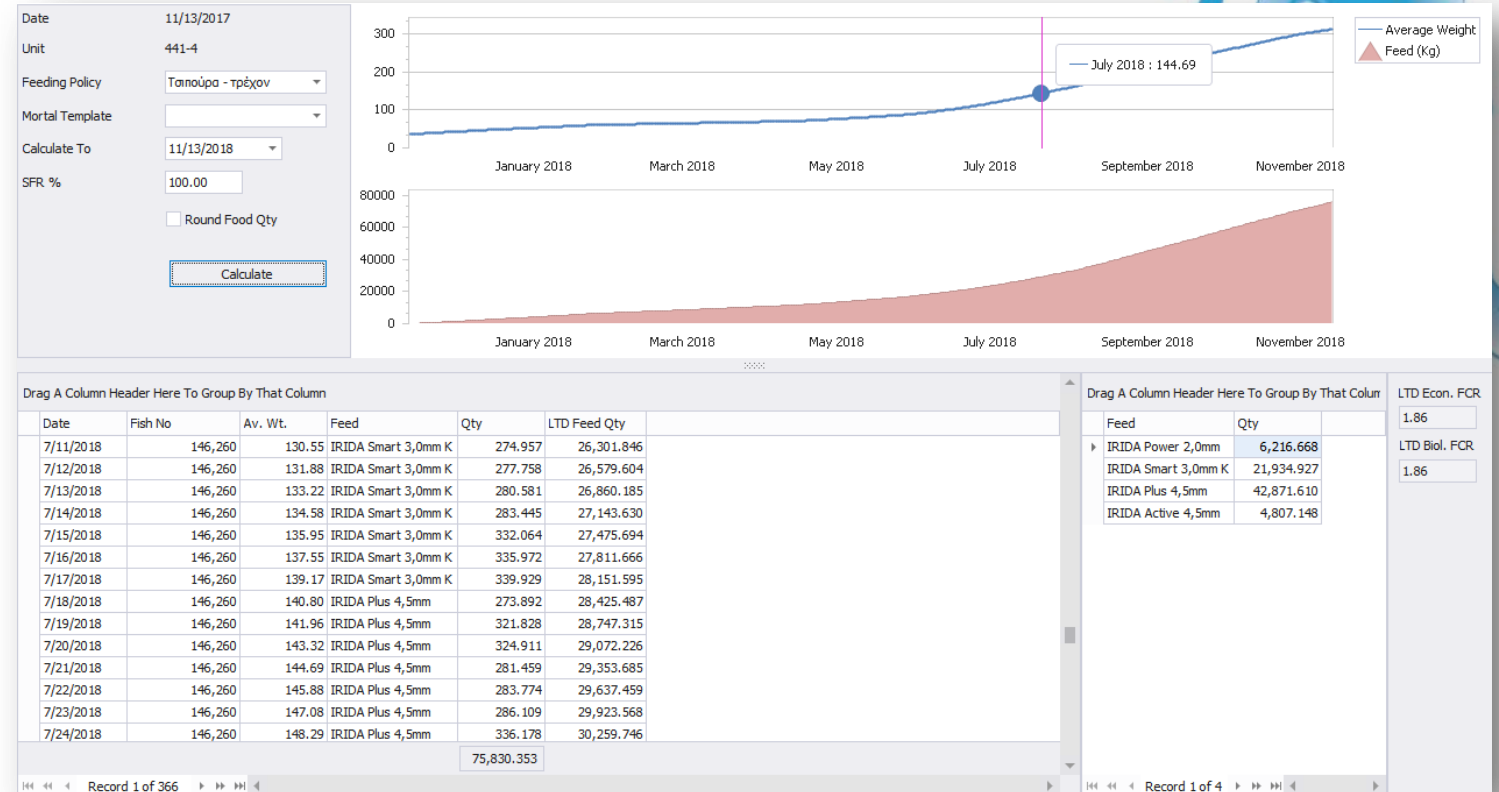
Open Sea, Cages, 4200 tons / year

## Achievement

More accurate production plans, the company knows exactly what size of fish will be available and when.

## Improvement

Increased credibility of the company, higher prices



# Operational Efficiency

- Workflow optimization
- Much more **organized** work, **mentality changes**
- Real time notification for the management crew in case of a problem
- Management reports generated **immediately**. Allows production managers to **save time, reduce paperwork, increase efficiency**

# Data quality

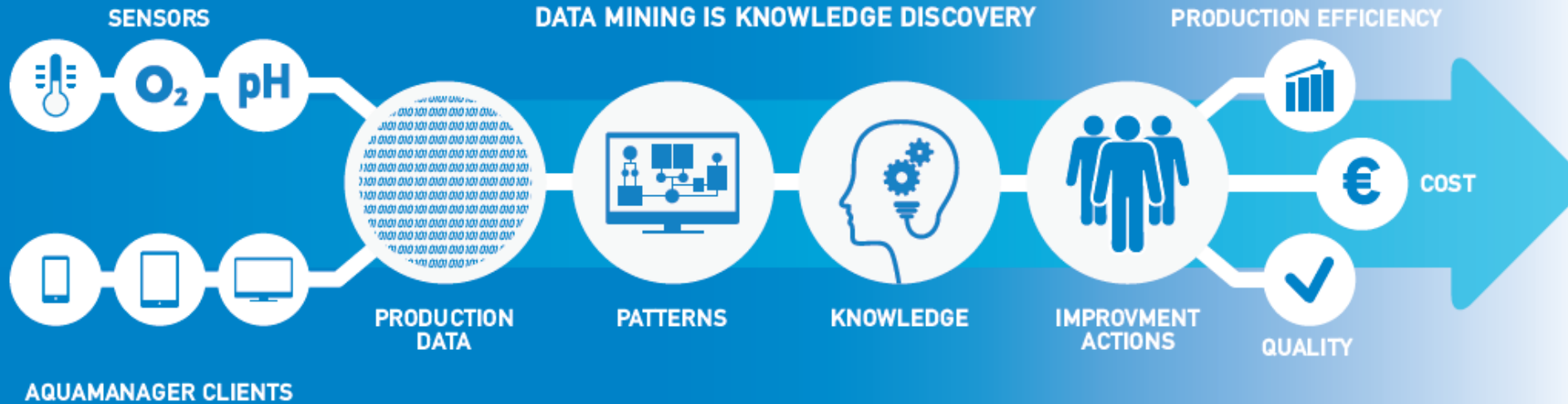
- ✕ Data Integrity.
- ✕ Less mistakes.
- ✕ Self control of the data that are registered
- ✕ The mentality changes
- ✕ Better decisions



# Knowledge Base

- Development of a knowledge base with valuable information on **fish growth** and **quality**, **best practices**, **growth policies** and **environmental data**.
- Knowledge stays in the company / organization even if a key staff member leaves
- New colleagues can easily learn how the farm operates and get productive quickly

# Knowledge Base



From automated data collection, to advanced reporting to business intelligence and data mining.

# Thank you for your attention!!!



We will be happy to hear from you!

If you have any comments, ideas or you would like to learn more, you may email me directly: [kostas.seferis@aqua-manager.com](mailto:kostas.seferis@aqua-manager.com)

Or you can visit our website  
<https://www.aqua-manager.com/>