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

Kostas Seferis
Business Development Manager
Integrated Information Systems S.A.
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!

- Daily Management
- Problem Identification
- Supplier Evaluation
- Optimize Feeding
- Performance Evaluation
- Cost Control
- Production Planning
- Data Analysis
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
Data Mining Process is a Knowledge Discovery process

Data are gathered to databases. Selecting data is necessary for analysis.

Data are preprocessed in order to remove missing values, detecting outliers and inconsistencies.

Transform preprocessed data to be in a suitable format to Data Mining algorithms.

Data Mining Algorithms are applied to produce descriptive (discover patterns, rules and trends) or predictive statistics.

The data mining results are evaluated in order to generate knowledge valuable to end-users.

Data Mining

Preprocessing

Selection

Preprocessed Data

Target Data

Data

Transformation

Data Mining

Preprocessed Data

Transformed Data

Patterns/models

Interpretation - Evaluation

Understanding

www.aqua-manager.com
Integrated model of the decision-making process

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

- **Private Data Sources**
  - Data
  - Structured

- **Public Data Sources**
  - Unstructured
  - Workstation
  - Servers

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

- **Data Mining Tools**
- **Generating Models and Decision Opportunities**

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

- **Decision Support System**
- Make a decision by Decision Makers
- Organizational Learning

12/07/2017

NWFCC2017

www.aqua-manager.com
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
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
A model has 3 components:

- Target
- Predictors
- Method

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
FCR and Mortality by Hatchery Box Plot
Machine Learning Model, identification of most significant parameters
Business Cases
Company
Open Sea, 5000 tons / year

Achievement
Development of new, optimized Feeding and Growth Models

Improvement
Reduction of feed cost by 6,8 %
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%
Data Validity
Prediction of harvest distribution
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
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

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