A TRAINING PROGRAMME TO SUPPORT AQUASMART PROJECT EXPLOITATION

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ABSTRACT

The deployment of enhanced frameworks or systems is a new business paradigm and implies significant change in behavior, process and tools within enterprises. This transformation requires efficient training of the different actors involved (managers, technicians, etc.), so that they are made fully aware of the tools and methodologies envisaged. The aquaSmart project has defined a training programme that has a goal of disseminating, but also transferring, learned knowledge to the aquaculture business stakeholders in accordance with the expected goals and outputs of the project. It has the ambition to foster new skills, knowledge and competences within aquaculture organizations to apply the aquaSmart analytics platform, which is suitable for fish farm production, to enhance production and efficiency in the sector.

KEYWORDS

Aquaculture, Training, Data Analytics

1. INTRODUCTION

Aquaculture is globally the fastest growing food industry that now accounts for nearly 50 percent of the world's fish that is used for food (FAO, 2018). Global population is expected to reach 9,7 billion people by the year 2050 (FAO, 2016). As population increases, so the need for more food increases. Thus, intensive agriculture or fishing in seas and rivers is not and will not be enough, so aquaculture is the solution to the protein provider for the world.

However, supplying big quantities of fish in an efficient and sustainable way represents a huge challenge. Aquaculture is a complex production, influenced by many interrelated parameters that have to do with environment, production management practices, feeding strategies, feed composition and the daily operation of the farms. Companies need tools and advanced technologies that can help them to optimize production, increase efficiency and at the same time reduce the impact on the environment (D. 5.3).

Companies in this area are facing some problems today, one of their main problems is that they cannot interpret the data they capture, or contemplate alternative uses for this data. If this was the case, they would be able to dramatically improve the production in terms of Feed Conversion Ratio (FCR), cost, mortality, diseases, environment impact, etc. Thus, it was created the project entitled "Aquaculture Smart and Open Data Analytics as a (Digital) Service - (aquaSmart)", a two-years project which started in February of 2015 and finished in January of 2017, funded by the Horizon 2020 Framework Programme of the European Union. This project aims to bring big and open data analytics as a service to the aquaculture industry to assist with this interpretation. The aquaSmart project does this through the creation of a cloud based platform, ensuring scalability, with a backend based on machine learning and data mining techniques, to aid aquaculture managers in their decision-making process. During the project it was developed two distinct products, a specific platform and respective training in the aquaculture area. Thus, the aquaSmart platform extracts knowledge from vast amounts of aquaculture data (environmental parameters, feed types, feed composition, feeding rates and practices, net changes and production management practices) and through the use of

accurate data analysis and predictive modeling will support production decision processes in the industry. aquaSmart allows companies to perform data mining at a local level and get actionable results as well as local results to be stored and then compared against others. This information have been represented in the ‘cloud, and in turn these comparisons are used for benchmarking purposes. Answering the needs of the aquaculture industry through the new developed technologies brought by the project, providing at the same time new digital skillsets via multi-lingual training and introducing a new level of data analytics into their mindset. By bringing together experts in several fields such as: aquaculture, machine learning, cloud platforms, standardization and training, which accomplishes the knowledge transfer, our resources were pooled together and exposed to this traditional but growing industry to key emerging digital technologies which provide specific tools to increase production and raising the quality level of the aquaculture fish, promoting at the same time the consumer's confidence.

The project also provide a key multi-lingual training elements to increase digital knowledge, and thus self-worth and value of employees. Furthermore, it was developed a CEN workshop agreement standard, based on the data science of aquaSmart, bringing the knowledge of data analytics and its use into the developed training. The training is available as classroom led instruction or online tutorials, also available on smartphone. Through regular social media and online channels, as well as word of mouth (important in this industry), we ensure the key message of using new technologies and accompanying digital training are constantly to the front of people’s attention, which is proven through a steady stream of requests for information or training sessions. All of this leads to large scale take up of our technology and training offering resulting in a more digitally aware labor force in the fish farming community. The project has had a longer impact, much than the 24-month project duration as we go entering into new markets.

aquaSmart’s impact is attained by the project providing the aquaculture industry with possibilities to bring Big and Open data analytics as a service to the industry to assist with interpretation of captured data not previously taken full advantage of (Sarraipa et al., 2016). The industry is now able to improve decision making process and thus increase profit margins. Through this measurable KPIs platform, managers will have a better view of the living inventory (biomass) that exists on a farm and will be able to make more accurate estimations on the growth of the fish, thus leading to better informed management decisions. Through the availability of multi-lingual Open Data, companies are able to compare their specific results with other results that are stored in the cloud. The project is scalable and replicable because the need is common to many sectors. Current alternatives for a company that wants data analytics will be to hire expensive consultants, that usually, do not know the business. Therefore, a lot of up front effort and investment is required before getting any return with results. Especially for SMES, and is something that is beyond their budgets. Then, the key factors driving the success of this initiative must be linked back to the close relationships we have built up with the fish farming community and thus ensuring that our work is focused in the direction that is answering key questions for the industry as perceived by the labor force on the ground. We are specifically answering their needs both in the technology that we are bringing to their industry, but more importantly we are providing them with the necessary digital skillset, through our training, to make full use of the expertise that the collaboration of the partners is bringing to the table. Through the training we not only provide them with guides to how the system will be used, but also provide them with the digital know-how or competences as to what is happening in the background and why, thus introducing a level of data analytics into their thinking and how they proceed in the industry going forward.

2. AQUASMART TRAINING

Data analytics is a very interdisciplinary study, which includes aspects from various scientific specialties' such as statistics, signal theory, pattern recognition, computational intelligence, machine learning and operations research. According to Runkler (Runkler, 2016), data analytics is defined as the application of computer systems to the analysis of large data sets for decision support. With regards to data analytics challenges in aquaculture, there is a need to obtain knowledge from analysed data to support smarter decision making, better production performance and ultimately a more efficient management process. There is the need to utilize this data analysis to help companies improve their production performance internally, but also to use open data processes to facilitate knowledge exchange across the industry.

The aquaSmartData Analytics Training Programme's mission concentrates on offering services, activities and materials, to deliver skills and competences, based on the knowledge acquired from data analytics performed, which in turn will facilitate the creation of new approaches or processes capable of adhering to the demanding sectorial change management to facilitate new business incomes. This program has been established with the aim of developing new skills, knowledge and competences to facilitate the application of the aquaSmartData Analytics platform, suitable for the fish farming industry, to enhance production and efficiency in the aquaculture sector. This aquaSmartData training also provides the required support for an efficient deployment of "an analytics tool for fish farms".

2.1 aquaSmart Training Curriculum

The training curriculum is specifically focused towards to the Business Owners; Information Technology Managers; Farm Managers; Production Managers; and Data Analysts but is also suitable for any person that is concerned with matters that affect today's aquaculture business. The aquaSmart Training Curriculum offers specialized training, and aims to generate an extensive impact in the field of aquaculture data analytics to facilitate new business incomes. Its objective is to disseminate and transfer knowledge to the aquaculture business stakeholders in accordance with the expected outputs and project goals.

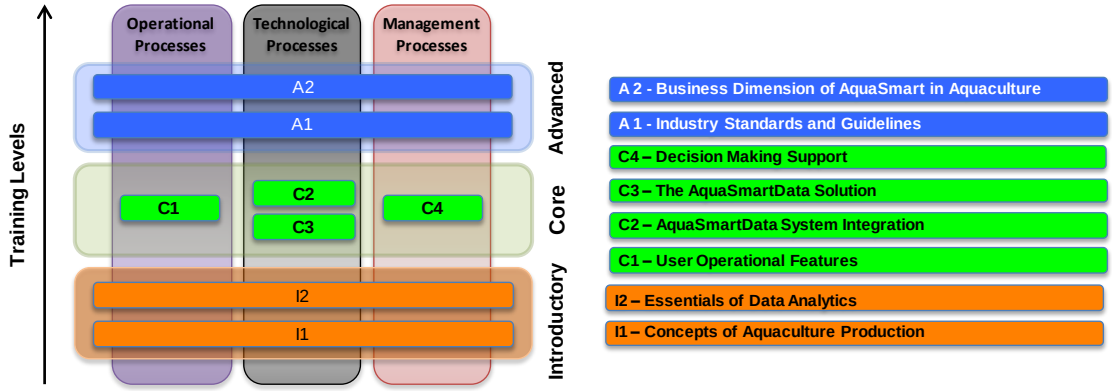

Figure 1. aquaSmart Training Curriculum

Thus, the aquaSmart curriculum areas presented in (Marcelino-Jesus et al., 2016) are based around the key project themes, which are also the fundamental dimensions of aquaculture business topics in relation to data analytics integration to improve its business processes (Fig.1). The 'Operational Process' relates to the common processes that an aquaculture enterprise executes in the act of feeding the fish. The 'Management Process' integrates actions taken to control the business efficiency of the enterprise, which would require constant and effective decision-making and the 'Technological Process' relates to the processes that integrate with advanced technological features such as measurements of sea characteristics through particular sensors, or the analysis of food quantity to selected fish species in relation to a particular environment condition or disease, etc. In addition to the 8 base training courses which are organized into 75 modules, there is also the facility to generate customized training through the ability of creating a 'pick and mix' reference training programme for each identified target group based on topics or skills. The main set of eight courses available are:

- Course 1 - "Concepts of Aquaculture Production", provides essential knowledge about Aquaculture, providing a rationale on aquaSmart solutions and Data Analytics.
- Course 2 - "Essentials of Data Analytics" explains how data analytics can work for aquaculture stakeholders. It clarifies how an analytical approach can be applied to an aquaculture business process and what are the benefits to be gained.
- Course 3 - "The aquaSmartData Solution" presents the aquaSmartData software's main features, providing instructions on how to install and additionally, presenting a demonstration that shows how to use the platform (DEMO).

- Course 4 - "User Operational Features" provides the necessary skills and competences to facilitate the changing or adapting of some of the current operational procedures of the aquaculture stakeholders, mainly from the farmers, to implement the aquaSmartData solution.
- Course 5 - "Decision Making Support" presents new reasoning methods for Aquaculture planning, based on knowledge acquired from specific data analysis tasks. It describes how these technologies can be used to support decision-making.
- Course 6 - "aquaSmartData System Integration" gives the integration instructions or guidelines for deploying the aquaSmartData software solution into aquaculture companies and how to conduct new development and maintenance procedures.
- Course 7 - "Industry Standards and Guidelines" show the relevant standards and guidelines to run an aquaculture business accordingly to the law, following interoperable and ethical procedures.
- Course 8 - "Business Dimension of aquaSmart in Aquaculture" is a guidance for adopting the project approach, which proposes the strengthening of data analysis in aquaculture to acquire new knowledge in the domain thus be able to foster innovation in the Aquaculture business.

These courses accomplish the proposed AquaSmartData Training Analytics Programme designed for the main aquaculture stakeholders plus data analysts due to its strong inclusion of aquaculture data analysis.

2.2 Training Services Technological Support

The aquaSmart training program is available in a Learning Management System (LMS), specifically the Moduler Object-Oriented Dynamic Learning Environment (Moodle), capable of providing training in virtual classroom /webinars and e-learning formats. This provides functions for evaluations, and feedback purposes which include tests for self-assessment evaluations, and feedback purposes. The infrastructure works as a repository for trainers pick up modules in various languages (e.g. English, Portuguese, Spanish, and Greek) to accomplish their specific needs for a particular training program execution.

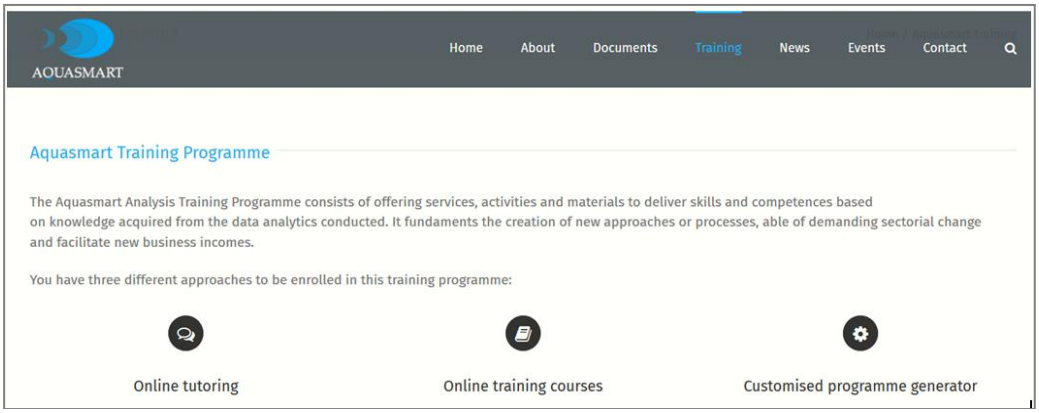

Figure 2. aquaSmart Training Services Platform

In the training program of aquaSmart platform trainees have different approaches to be enrolled according to their profile and needs. From the technological point of view, the main functionalities provided by the aquaSmart training platform are: online tutoring, online training courses and customized programme generator (Fig.2). The functionalities are described hereafter in detail.

2.2.1 Online Tutoring

In this case, the Online tutoring option, is a service supported by "Moodle" and intends to give tutoring in an online environment. If a trainee chooses the online tutoring option, it is presented a webpage platform were it is presented a main menu, the navigation site, a calendar, and a list of the available courses as well as the possible interactions between the trainee and the trainer.

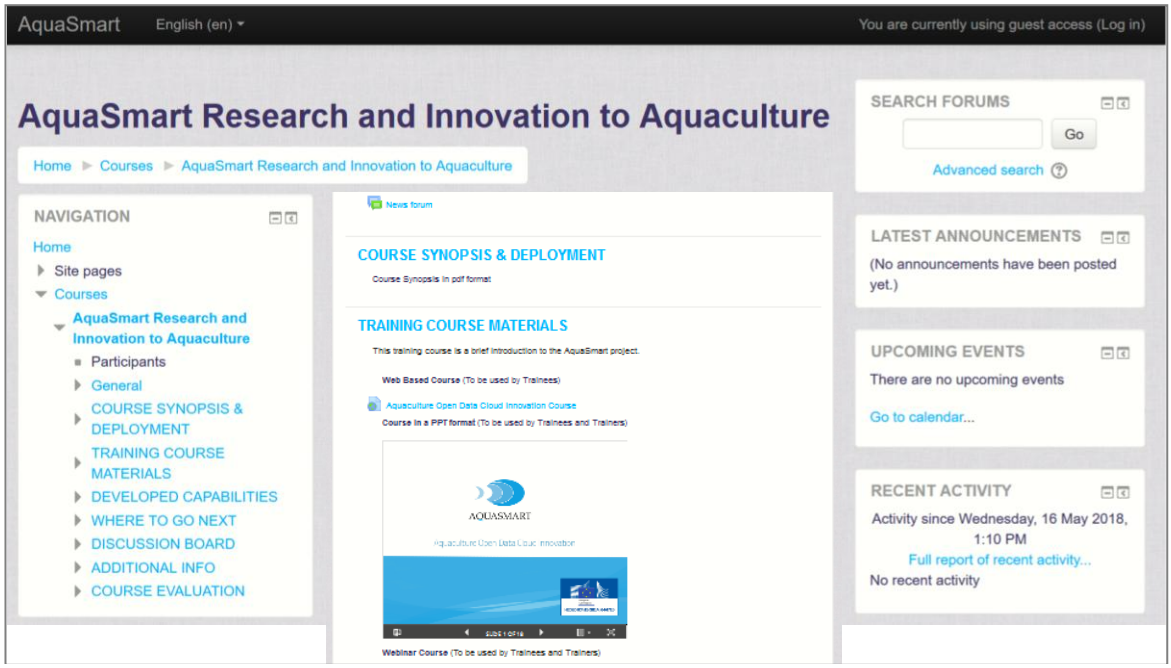

Figure 3. Webpage for "AquaSmart Research and Innovation to Aquaculture" online tutoring course

When a specific course is selected it is presented a webpage represented in Figure 3 with some tools and available information that support's the online tutoring, including the main sections: course synopsis & deployment, training course materials, developed capabilities, where to go next, discussion board, additional info, and lastly the course evaluation. Additionally, it is also possible to search keywords in forums, to see the latest announcements, upcoming events, and the recent activities.

2.2.2 Online Training Courses

Online training courses" service offers to the trainee a list of available courses, specifically: "AquaSmart Research and Innovation in Aquaculture", "Concepts of Aquaculture Production", "Essentials of Data Analytics", "The AquaSmartData Solution", "User Operational Features", Decision Making Support", "AquaSmartData System Integration", "Industry Standards and Guidelines". "Business Dimension of aquaSmart in Aquaculture" (for details about these courses please see subsection AquaSmart Training Curriculum). For each course it is presented a brief description, and which modules belong to it. To make available this service, the Moodle was configurated.

2.2.3 Customized Programme generator

aquaSmart training program allows to create customized training programmes available through the Moodle platform. Those programs can be tailored to the aimed skills for each trainee. In order to make personalized courses according to a specific profile (e.g. use of analytics, feeding fish, farm management), it is necessary to use an ontology to define the structure of the training curriculum. Figure 4 shows the relations between training concepts build in an ontology using Protégé.

Figure 4. Part of the training course ontology (Rajaonah B., et al., 2018)

The aquaSmart training ontology represents the Knowledge Base (KB), that allows both to structure its elements and promote reasoning operations over them. Since it represents the training curriculum it can as an example, orchestrate a training programme integrating only the training modules associated to a desired topic in a specific order accordingly to required procedures. The service for the creation of customized training programmes is based on the aforementioned ontology establishing orchestration over the existent training modules and courses.

2.2.4 Scenarios

Next will be described three possible scenarios corresponding to the previously mentioned training options: training course, online tutoring, and customized programme generator.

Online Training Course

As a trainee I want to attend a course in the context of AquaSmart, however I don´t know exactly the content of each course. Then I should choose the "aquaSmart Training Services Platform" represented in Figure 2 to access to a description of each course to support my choice.

Online Tutoring

As a farmer in Greece, I want to develop my own aquaculture system and I need to understand new technological solution in the domain. Then I should attend an online training course based on AquaSmart materials available for farmers. Thus, I should log in Moodle (Fig.3), download the AquaSmart training materials and make use of BigBlueButton Moodle, that is web conferencing system for distance education allowing real-time sharing of slides, webcams, whiteboard, chat, audio, and voice over IP (BigBlueButtonBN - MoodleDocs, 2017).

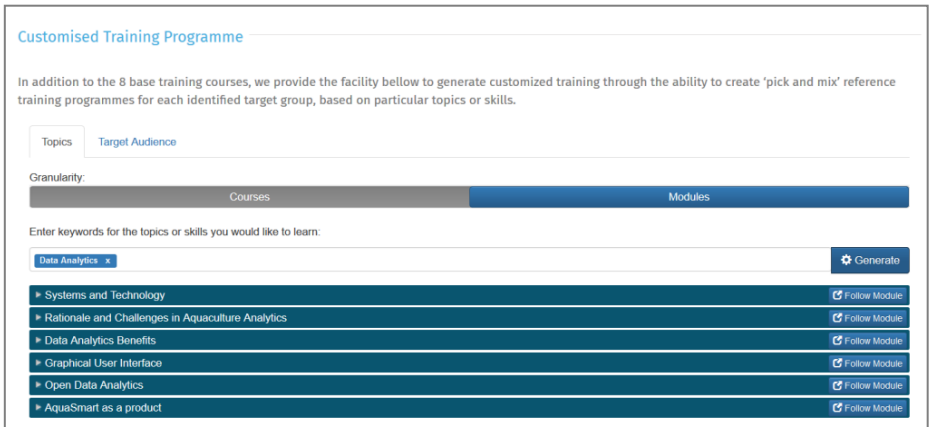

Figure 5. Customized Training Programme Webpage

Customized programme generator

As a software developer I want to study about data analytics. Then at AquaSmart training platform I should choose the “Customized programmer generator” option (Fig.2) and next I should select the option "modules" and insert the key-word “data analytics” to the system be able to generate a customized training programme for that purpose. Figure 5 illustrates the training programme generated for this example.

2.2.5 Feedback on the Sustainability of the Developed System

During and after the aquaSmart project life-cycle the project itself and its consequent results were presented in all the major aquaculture conferences all over the world and interactions with the main stakeholders of the industry, from researchers, to suppliers of goods or services and consultants. Feedbacks were obtained and collected during these events.

The combination of the sector needs, the aquaSmart answers to these needs and the practical benefits from the use of the platform in real-life situations are the necessary ingredients to successfully support market deployment of this aquaSmart technology.

According to Nir Tzohari, Production Manager at Ardag Cooperative Agricultural Society, Ltd (Ardag) from Israel, Ashdod fish farming site and one of the end users in the project reports that "*with aquaSmart we can really dig into the data and easily analyze the data and figures and their relationship against the performances in a very clear and easy manner. In doing so, aquaSmart helps farmers to put the spot light on the points of our operations where treatment and improvement are needed. Moreover, all of this gives us the opportunity to create a model and immediately thereafter to take more informed decisions and make predictions. I really believe that aquaSmart will move the industry forward by making all size of farms, from big enterprises to small scale, being able to make good analysis through all of the grow-out steps"*.

Offering aquaculture production companies the tools to access and share global open data and strong data analytics in a cross-border setting strengthens their competitiveness and growth potential. The aquaSmart project has been driven by the business needs of the European aquaculture companies and has been developed in a way that allows the companies to achieve practical and measurable benefits (D. 5.3).

One point that end users emphasized and provided feedback is that this aquaSmart analytical tool can be very useful for production analysis and optimization of multiple species, irrespective of whether they refer to marine or freshwater aquaculture. The direct implication is that the platform can positioned equally strongly for all species and not only for sea bass and bream, which means that the potential customer base can be significantly bigger. Specifically, for business case "Evaluation of feed performance" they emphasized that aquaSmart can create high value to them as its models can be used to assess and evaluate different feed types and take smart decisions on feeding, without taking the cost of real trials in their actual production. End users confirmed the critical importance of feed evaluation in the production process, as the cost of feed can reach up to plus seventy percent of their operating expenses, with a direct impact on profitability. They also mentioned the following two points and characterized them as critically important: a) the fact that aquaSmart can help them to get a reliable estimation of the fish number in a unit/site, which is an on-going challenge for them and b) benchmarking, which is always desirable but not easy to be done.

They referred to both internal and (most importantly) external benchmarking, stressing that data confidentiality is a critical consideration for them before engaging with aquaSmart. This concern is fully covered by the fact that the platform does not allow access to benchmarking unless there exist more than three users with similar production profiles (D. 6.4).

3. CONCLUSION

The main objective of the aquaSmart Training programme is to develop new skills, knowledge and competences to apply the aquaSmartData Analytics platform suitable for fish farm production to enhance aquaculture production and efficiency. Its aim is to enable best practices and better production costs in aquaculture, and all personnel will be empowered through this training programme with skills to better perform their actions in using, installing and maintaining aquaSmart solutions. The training programme includes 8 training courses organized into 75 modules, available in multiple languages, so that each module can be used in dynamic sequences to better fit each user/trainee profile. Thus, it includes presentations with text, visuals and narrative so that the message can be seamlessly transmitted to the attendees. There is also an

evaluation procedure that allows a better assessment of training effectiveness and to give clues about possible improvements. The web course versions are also available in mobile applications so that the users will have more freedom of attendance and eventually more comfort and time scheduling to learn. All of this has been provided for in the formal specification and ontology as proposed by Sarraipa in (Sarraipa et al., 2012) enables the creation of a customizable training programme. This provides additional functionality affording enterprises or communities with an efficient knowledge transfer instrument, in order to better transmit aquaSmart results to the identified target audiences.

Concluding, in additional to a proposed approach where aquaculture business experts can use advanced technologies to solve their problems in a practical way they can also be trained up with the support of a solid training programme about the use of these tools. It also explains the needs for production optimization through data analytics; it provides an overview of the outlook of the sector and how such proposed aquaSmart solutions answer these needs.

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