Industrial product platforms and blockchain in aquaculture

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Abstract. Modern technologies and new management concepts - industrial and product platforms - allows create new products and services, changes one of the oldest occupations of mankind, almost biblical, - fishing and fish farming. Due to the rapid development of IT technologies and business in the last decade, the development of platforms has been observed - network business structures engaged in the collection and analysis of heterogeneous information for users. The most important platforms for aquaculture are industrial and product. The newest concept of innovative economy – blockchain, - must be also used in modern industrial aquaculture. We propose the product platform based on an industrial platform, - software and hardware complex for fishes and crustaceans farming using Computer Vision technologies and modern automation systems integrated into a network industrial complex. The environmental parameters for optimizing the growth rate of aquatic organisms or their taste are subsequently distributed (license/sales) among users of their product platform. Platform users could collect fishes and crustaceans into the trading pools and sell them to large retailers for special prices. Product platform helps preserve, repopulate endangered species of fish and crustaceans and also reduces ecological impact of fisheries and extensive aquaculture.

The convergence of modern technologies and new management concepts [1] - industrial and product platforms [2] - allows create new products and services [3], changes one of the oldest human occupations, almost biblical, - fishing and fish farming. Their creation was made possible thanks to the improvement of innovative processes. Chronologically, the first was the linear process of the “technological pressure” (from science to the market), the development of science was objective, independent of the market. It can be traced by the scientific revolutions and the change in technical patterns correlating with them. The following linear process of “market push” (from market needs to science) connects the development of the innovative potential of the economy with market requirements. The processes of “push” and “pressure” are two extremes of the general process of interaction - an interactive model that simulates the nonlinear nature of the innovation process. In the last decade, the drop in the cost of communications, the rapid development of artificial intelligence (AI), the advent of the Internet of things (IoT) and the big data industry (Big Data), the blockchain has forced the transition from a linear to a network model of innovation management. The key components of network model are flexibility and speed of updating. The transition is based on platform solutions.

Due to the rapid development of IT technologies and business in the last decade, the development of platforms has been observed - network business structures engaged in the collection and analysis of heterogeneous information for users. The purpose of their activities is to increase the efficiency of
interaction between all interested parties (business, science, the state and public organizations) by combining potentials to stimulate mutually beneficial innovative development, creating centers of competence, shaping the economy of the future, continuous technological renewal, and increasing global competitiveness.

Moazed and Johnson [4] introduce a ladder that defines the development of network quality:

- Community: behavioral norms in the platform ecosystem
- Interconnection: the maximum possible number of interactions
- Collaboration: ecosystem actors collaborate to create added value.
- Communication: the interaction of actors
- Curation: storage and analysis of ecosystem information

The chronology of the emergence of 5 types existing platforms (at the end of 2019): advertising platforms (Google, Facebook, 2000), cloud platforms (Amazon Web Services (AWS), Salesforce, 2005), industrial platforms (GE, Siemens, 2008), product platforms (Rolls-Royce, Spotify, 2012), lean platforms (Uber, Airbnb, 2015). Let us consider in more detail the most significant platforms for aquaculture: industrial and product platforms.

Industrial platforms create the equipment and software necessary for transferring traditional production to Internet rails, which will reduce production costs. As data collection, storage and analysis becomes cheaper, more and more companies are trying to implement it in traditional manufacturing platforms. The most notable of these attempts are under the rubric of “Industrial Internet of Things,” “Industry 4.0.” Industrial Internet reduces labor costs by 25%, energy costs by 20% (data centers distribute energy), and operating costs by 40% due to timely alerts on wear points. Competing with more versatile platforms like AWS, industrial platforms emphasize their insider knowledge of production processes and safety requirements when developing such a system.

Product platforms generate income using other platforms and with their help transform a traditional product into a service collecting rent or monthly fee. The most notable industrial example is the transformation of the jet engine market: from sales to rental. First in the world Rolls-Royce LTD introduced the “goods as services” business model: airlines do not buy engines, but pay for their use on an hourly basis.

According to the forecasts of demographers, in the XXI century the population on Earth will reach 15 billion. Currently, 1 billion people are chronically starving. The R&D must be concentrated in the field of new technologies and more rational food production, which can reduce the load on natural biosystems.

Industrial aquaculture has been intensively developed in the world. with high fish landing densities are applied and high output per unit area is achieved. The highest form of industrial aquaculture development is the cultivation of fish and other aquatic organisms in closed water systems, - Recirculating Aquaculture Systems [6]. World aquaculture is actively developing and expanding its geographical boundaries, conquering international markets. The state of world aquaculture objectively indicates an increase in its share in the overall balance of fish production. In 1975, aquaculture products accounted for only 11% of the total fish production, in 1985 - 12.3%, in 1994 - 20.6%, and in 2001 - 34.4%. In 2006, this figure reached 43%, and in 2009 - 50%. In 2018 China produced 82% of fish in aquaculture conditions. Fish account for about 17% of animal protein consumed globally, providing approximately 44% of the human population with 20% of their animal protein needs. In the period of five decades, global fish consumption peaked in 2016 at about 171 million tonnes. In per capita terms, we consumed fish from 9 kg in 1961 to 20.2 kg in 2015 [7]. However, in Russia the situation is very deplorable. For example, in the early 2000s, Russian Federation produced 4.3 million tons of fish, of which only 135 thousand or 3.5% were aquaculture products. In 2019, the global fish market represents $ 260 billion, the share of aquaculture is 53%.

The use of biotechnology [8] in aquaculture, as well as genetic methods [9] in breeding fish and crustaceans, can significantly increase the productivity of modern industrial aquaculture. The only

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thing that slows down researchers and entrepreneurs is the lack of modern legislation in the field of platform business models and the production of genetically modified products [10].

Atea, a Norwegian startup, believes that industrial aquaculture is being criticized today because of a lack of fish and a negative impact on the environment. For the Norwegian aquaculture industry and Atea in particular, high-tech industrial aquaculture play a major role. Based on the FISHWELL industrial platform, aquaculture industry participants harness the potential of Big Data, AI, Machine Learning and Computer Vision [11]. By standardizing on the principles of “Industry 4.0”, the structure of data collection, analysis and accounting, industrial aquaculture will benefit from new technologies and management models, and will also be able to improve relations with municipal and federal authorities. The aquaculture industry, built on an industrial platform, will achieve greater profitability, better fish quality and at the same time take care of the environment [12]. IoT and Computer Vision will monitor and control the conditions in which fish live [13]. The same technologies will allow you to accurately determine how many tons of fish are in the RAS and predict its increase. These data will allow you to calculate the profitability of production and determine the timing of the sale of fish.

Industrial aquacultures platforms are useful for city farming. It is possible to use it both in metropolis [14] (New York) and in less developed areas [15] (Bangladesh). Ensuring food safety, improving product quality and logistics of Smart Cities is possible only using city farming technologies - growing food in the same area where their consumers live. The first sprouts of high-tech agriculture - hydroponics, aquaculture, aquaponics - arose in the 60s of the twentieth century in Japan with the advent of the first transistors. The active growth of city farming took place in the 21st century and coincided with the democratization of the prices of LEDs [16] needed for round-the-clock and year-round cultivation of plants. It became also possible due to dissemination of industrial electronics in the framework of “Industry 4.0". By the end of 2022, the Shanghai government will build on 100 hectares of territory the urban agricultural region of Sankyao. The Shanghai municipality will arrange the supply of 24 millionth megalopolis with fresh agricultural products. The planning of this area is the responsibility of the American architectural bureau Sasaki Associates. The quarter Sankyao tends to rise vertically and composed with hydroponic farms, fruit and vegetable gardens, RAS for growing algae, fish and crustaceans, greenhouses. In 2018, the Panasonic Agrolaboratory was created at the Skolkovo Russian Innovation Center for adapted city farming technologies for Russia. Panasonic Agrolaboratory collaborates with leading Russian universities - Lomonosov Moscow State University and Moscow State Agricultural Academy named after K.A. Timiryazev, - which allows scientific control when growing environmentally friendly products in the megapolis.

The implementation of the full life cycle of the RAS installation is possible through the use of blockchain technology [17], which will reduce costs, track the condition of parts and increase the cost of RAS in the secondary market. According to PwC, they plan to use blockchain technology in the aerospace industry. By analogy with the aerospace industry, blockchain will reduce costs by creating a digital certificate for each RAS part, which will reflect all the data:

- name of the manufacturer
- delivery and installation details in RAS,
- The unique RAS number on which the part is installed;
- information about its location in the RAS,
- scheduled maintenance information,
- personal data of RAS technicians who worked with this part;
- service locations

In parallel, information about fish or crustaceans produced at these facilities is recorded on the blockchain. Under 2018 U.S. law, The Seafood Import Monitoring Program - or SIMP - establishes reporting and recordkeeping requirements for imports of certain seafood products, to combat illegal, unreported and unregulated (IUU) -caught and / or misrepresented seafood from entering U.S.
commerce. A ban on the sale of 11 species of fish and all crustaceans is introduced if their origin is not traced.

As a product platform based on an industrial platform [18], we develop a Smart Living System (SLS) software and hardware complex for highly profitable fishes (Huso huso × Acipenser ruthenus,…) and crustaceans (Cherax quadricarinatus,…) using Computer Vision technologies and modern automation systems integrated into a network industrial complex. Computer Vision monitors the growth of aquatic organisms and optimizes the parameters of the aquatic environment and the distribution of food pellets. SLS units integrate into a common Network / Ecosystem RAS installation for fish and crustaceans [19]. This will allow SLS to collect data on the parameters of the aquatic environment for each species of fish and crustaceans, analyze them and calculate the optimal parameters for all installations. The optimal environmental parameters for optimizing the growth rate of aquatic organisms or their taste are subsequently distributed (license / sales) among users of the business ecosystem. General monitoring of the SLS using Computer Vision allows analyze the total biomass of fishes and crustaceans, its growth rate and the return of investment (ROI). For a certain percentage from the transaction SLS suggest users of the product platform to collect fishes and crustaceans into the trading pools and sell them to large retailers. SLS RAS is connected by a common blockchain system, which allows to increase the transparency of the business ecosystem. All the transactions could be done also with the cryptocurrency – the ASIC must be used to heat water. In addition to agribusiness (aquaculture, hydroponics, greenhouses, …), the developed product platform (SLS) can be easily adapted to other industries.

The target clients for SLS product platform are: rural aquaculture farmers (SMEs) and potential entrepreneurs from city farming. SLS product platform helps preserve, repopulate endangered species of fish and crustaceans and also reduces ecological impact of fisheries and extensive aquaculture.

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