Development of fishery information system for production processes organization

Aleksandr Krasnikov\textsuperscript{1},*\textsuperscript{}, Elena Romanova\textsuperscript{2} and Olga Kireeva\textsuperscript{2}

\textsuperscript{1}Moscow Polytechnic University, Moscow, Russia
\textsuperscript{2}Russian State Social University, Moscow, Russia

\textbf{Abstract.} The article substantiates the relevance of developing a software product that carries out the digitalization of the country’s fisheries management processes. The use of general scientific methods of structural analysis, synthesis, and formalization allowed us to develop a formal model of the subject area. Such a model became the basis for using object-oriented programming methods to obtain a full-fledged multi-user information system. Graphic images of screens of mobile and web-oriented versions of the system with a description of the functionality of user categories are presented. The developed information system allows to systematize and unify fishery processes, provide state control of the industry, and attract monetary investments into the industry.

\section{Introduction}

Accelerated development of communication and electronic means providing information storage and processing form the information environment of the organization, regardless of its activity. All this requires constant and complex changes in the requirements of the management system and organization of production processes [1]. The work of any company requires interaction between working groups and individual employees, effective distribution of material and labor resources, planning and control over the execution of assignments, and tasks, operational management, and implementation of a number of conditions for the implementation of production processes of the relevant branch of the national economy [2]. To implement the above processes, specialized information systems are used that can systematize the company management processes, quickly and accurately collect, process, and transmit data to employees, automate work processes, and act as a tool that forms recommendations for employees to make decisions on certain professional issues [3]. Thus, the use of software tools in any company is a justified decision that contributes to its economic efficiency and competitiveness.

Companies engaged in agriculture require specialized software due to the specifics of the organization of production processes [4, 5]. This is due to constantly changing and difficult-to-predict climatic and weather conditions, seasonality, susceptibility of products

\* Corresponding author: askrasnikov@gmail.com

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).
to diseases and their destruction or damage by pests, and strict adherence to technological charts and regulations [6, 7].

The listed factors have a significant impact on fisheries that provide the population with food and biologically valuable balanced products (e.g., quick-frozen meals, canned food, preserves, culinary products, semi-finished products, and combined products) [4, 5, 8]. Technological development of the fishing industry contributes to efficient production activities and, as a consequence, to the social and economic development of the country.

Based on this, the study aims to design and develop an information system that provides organization and management of fisheries processes. For this purpose it is necessary to establish all key objects of the problem domain and the processes arising between them, to formulate the rules of their interaction to create a formal model of the problem domain. Based on the obtained formal model, determine the methods that allow implementing its programming, and developing a user interface for the interaction of users with the functionality of the system depending on their roles.

The theoretical significance of the study lies in the systematization and formalization of processes characteristic of the fishery. The practical significance of the study lies in obtaining the results necessary for creating the concept of modernization of the fishery, the development and implementation of software solutions to improve production processes, and ensuring state regulation of the industry.

2 Materials and methods

We used technologies and methods of the spiral model of the software product life cycle, which is a combination of design and staged prototyping processes to achieve this goal [9]. Each stage of the model required the use of structural analysis, synthesis, and grouping techniques to derive the prototype requirements. With the help of the above methods, it was possible to obtain a detailed description of key objects and related processes and create formal models of individual elements of the problem domain using information modeling methods [10-12].

Object-oriented programming methods were used to transform the obtained models into information system objects. This methodology allowed transforming the objects of the formal model into classes with a description of their parameters and behavior. The use of classes allowed the use of the basic principles of object-oriented programming to write program code. The use of this approach to the creation of a software product is found in studies aimed at obtaining an information system to manage different processes in an organization [13, 14].

3 Results

As a result of using the stated methods, an information system with client-server architecture was developed. For ease of use, coverage of a large number of people, division of functionality between different categories of users, the client is presented in two forms: as a mobile application and an application with a web-oriented interface. Let us present a description of the fragments of user interfaces, the categories of users to whom they are available, and their corresponding functionalities.

Map of water bodies. Provides for drawing the boundaries of water bodies on a geographic map. It is possible to view background information on the water body: belongs to a closed area (e.g. fishery), fish species (for publicly accessible water bodies), fishing rules, and general characteristics of the water body (e.g. area, currents, depths). With these
functionalities, the map is available in a mobile app and a web-based version for unregistered users. The screen image of the web version is shown in Figure 1.

Fig. 1. A web-oriented version of the water bodies map.

For a registered user, detailed information about water bodies is available (incl. the mobile version – Figure 2). Such a user is an employee of the fishery and, accordingly, can view information on the current status of water bodies with access. For example, to view images from video surveillance cameras of the territory near a water body in real-time, to generate statistics on water temperature changes and other characteristics.

Fig. 2. Mobile application screen with interactive map of water bodies.

It is possible to get detailed information on the water body by pressing the transition arrow of the pop-up tooltip.

It should be noted that colors indicate the availability of water body information depending on the user category. For example, a water body area colored green means the detailed information is available, and red means there is no information.

Electronic Handbook. For all categories of users in all versions of the information system, the possibility of viewing the description of fish that live in a water body is available. Figure 3 shows the corresponding screens.
Fig. 3. Mobile and web-oriented versions of the fish guide.

The user can view detailed information about the selected fish species (as shown on the mobile application screen in Figure 3). For ease of navigation and information retrieval, there is a “link” to the water body for each fish species. On the corresponding page, it is possible to perform a text search and filter the retrieved values according to different characteristics (e.g., fishing methods, weights, etc.). Filter and text search work together as shown in Figure 3 for the web version of the corresponding page of the information system.

It should be taken into account that information on fish species that are farmed in the farms is not available to the user, as such information is classified as a commercial secret. The possibility to view the list of farmed fish is possible only in those farms, which provide services to the public for the sale of live fish or organization of commercial fishing on open waters. Figure 4 shows the screen of the mobile application with the description of fish species available in the water body and their release dates.

Fig. 4. Mobile application screen with information on farmed fish.

**Handbook of tasks.** Available only to an authorized user with the *Technologist* role. Tasks are formed automatically depending on climatic conditions in the water body (based on processed data received from sensors), periodic types of work to maintain fish-keeping conditions (e.g., sanitary work schedule established by the organization’s regulatory documents), fish rearing periods, etc. Individual tasks may be assigned by the *Chief Technologist*. Each task has a priority of execution, so the order of their display in the list is arranged from the highest priority task to the lowest priority task (the screen of the mobile
application is shown in Figure 5). The technologist marks completed tasks, which are added to the archive.

![Fig. 5. Mobile application screen with a list of water body maintenance tasks.](image)

The application provides the ability to customize pop-up notifications for the user with a set interval of information.

It should be noted that the same task within one water body can be defined for several staff members. Accordingly, it will be displayed in the task list of each employee until it is completed by each of them.

**Automatic image recognition.** Each type of user in the mobile version of the system has the opportunity to recognize fish species from the image obtained from a cell phone camera or a downloaded image (Figure 6).

![Fig. 6. Mobile application screen for recognizing fish species.](image)

For an authorized user, it is possible to view additional information about the fish caught (e.g. size, possible age, visible diseases, etc.). Regardless of authorization, the information system collects information about the fish caught and, if necessary, makes changes to the list of fish available for viewing on the *Map of water bodies*.

For the non-fisheries user, a subscription option is available to enhance the capabilities of the mobile app when using the Water Bodies Map and Fish Recognition feature. For a user with a subscription, it is possible to view information about the fish caught in a publicly accessible water body, get information about fishing gear, types of fish available for catching, etc.
Let us separately consider the functionality of the user with the *Chief Technologist* role. The *Chief Technologist* in the system can view various statistics (e.g. about works performed, current state of water body or fish), form schedules of *Technologists*, make changes, add or delete information about water bodies used in the farm or new objects, add users with *Technologist* role to the system and determine availability of water bodies and tasks for each of them.

*The Administrator* role is used to keep the entire system running. It keeps the data up to date, manages subscriptions and access levels for each user category, provides system updates, and performs version control.

4 Discussion

The developed software product corresponds to the problem area and allows to systematize of the fishery processes related to personnel management. The resources and functions of the information system are available depending on the user’s role. This finds confirmation in a number of developments related to business process management [2, 6, 13]. A mobile version of the information system has been developed for ease of use and prompt information about changes in any conditions at fishery facilities. This approach can be found in a number of works related to cross-platform application development [1, 4, 14, 15].

The reliability and validity of the obtained results in the functioning of the information system correspond to the problem domain since standard methods of obtaining formal models were used to create such algorithms. Based on these methods, the input parameters of the model and their transformation rules depending on the change of external indicators are obtained, which is in line with the results obtained in related studies related to the modeling of the problem domain [10-12].

The obtained program product can be used not only within fishery farms for process management but also for training profile specialists. As noted in the works related to the organization of practice-oriented training, the use of specialized software during the mastering of special disciplines and all types of certifications allows to form professional competencies and work out mechanisms for responding to different situations arising at work [16-18].

5 Conclusion

The Russian fish industry is at the stage of innovative development. The problems of the industry have a complex nature, the solution of which should be based not only on the use of economic tools but also on specialized software. Such tools become an additional tool to monitor conditions in the organization in real-time, to participate in the processes of development of management decisions considering the specifics of the industry and a particular farm (e.g. seasonality, climatic and weather conditions, resource consumption).

The use of software allows to ensure full-fledged state management and control of the industry, promptly receiving signals about the problems that have arisen, requiring the attraction of funds from state programs (it is possible to attract private investment in this way). In addition, information resources are unified and systematized, allowing to organize a single platform for the provision of fishery services to the public and business.

References
10. M. Logachev, E. Tolkacheva, S. Shibaev, V. Chernova, A. Butyrin, E3S WoC 403, 07011 (2023) https://doi.org/10.1051/e3sconf/202340307011
18. O. Korotun, E3S WoC 403, 02020 (2023). https://doi.org/10.1051/e3sconf/202340302020