Methodological Basis for Training Cadets/Professionals and Developing the Risks Management System in Maritime Shipping and Industrial Fishery

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Abstract

Activity in the field of the industrial fishery is associated with risks determined by the state of the environment. In this regard the development of methodological approaches to the design of risk management systems in industrial fishery is relevant. The paper presents an approach to develop a concept of the risk management system for industrial fishery including catching biological resources of the World Ocean and transportation of raw materials. The suggested concept consists of four stages. The paper presents a structure of the adaptive processing model of risk management. This model reflects the processes and their relationships by means of which the risk management is carried out. The formation of the risk management system structure can be realized in three variants. The paper demonstrates an example of such an organizational structure (the state structure of the Russian Federation).

Keywords: Risk management, Industrial fishery, Shipping, Training, Methodology

Introduction

The theory of risks in various spheres of human activity has received significant development in recent years [1,2,3,12,13]. Since the 70s of the last century, much attention has been paid to the development of scientific tools and technological support for the theory of risks [12].

As the analysis of scientific and educational literature of the last decades devoted to security and risk issues has shown there is a certain substantive focus in this problem. It is the assessment of financial, economic, environmental, natural and technological, social and political risks.

Activities in the field of the industrial fishery are associated with risks determined by the state of the environment. It is very often characterized by extreme conditions (hurricanes, storms, fogs, cramped conditions, etc.).

However, it is important to consider not only the risk assessment issues but also the matters its management. It has become in many key areas of activity including human activities at sea. In particular, these issues are not considered/investigated towards the field of industrial fishery.

Due to the fact the development of methodological approaches to the design of risk management systems in industrial fishery is relevant.

It should be noted that there is an opinion [5] that it is incorrect to speak about risk management, because "… cannot control that is not under control". But, the "risk management" provides just the "controlled" risk.

The concept of risk management in industrial fishery

Stages of developing the concept

The approach of developing the concept of the system of risk management in industrial fishery including catching biological resources of the World Ocean and transportation of raw materials consists of four stages.

The first stage includes defining the mission and goals of the system; the safety policy in the field of shipping and industrial fishery and formation of a monitoring subsystem and a database of the accident rate, fishing accidents, extreme phenomena of nature, etc.

The second stage consists of an analysis of factors affecting human activities at sea and identification of risk factors; an analysis of cause-effect relationships and defining risk indicators, criteria of their significance, determination of the possible level of damage and the allowable amount of losses.

The third stage includes: identification of the mechanism and resources for the effective risk management; development of scientific tools and methods to predict or reduce the level of risks; creation of regulatory support of the risk management system.

At the fourth stage training professionals for the risk management, formation of organizational risk management structures for all levels of the hierarchy, creation of a rational and effective mechanism to control functioning of the risk management system are carried out.

A conceptual model of the system of the risk management in industrial fishery during fishing and transportation of raw materials is presented in Figure 1.

The purpose of creating the risk management system is to increase the safety level of these processes, including by managing risks and reducing their negative impact on human activities at sea.

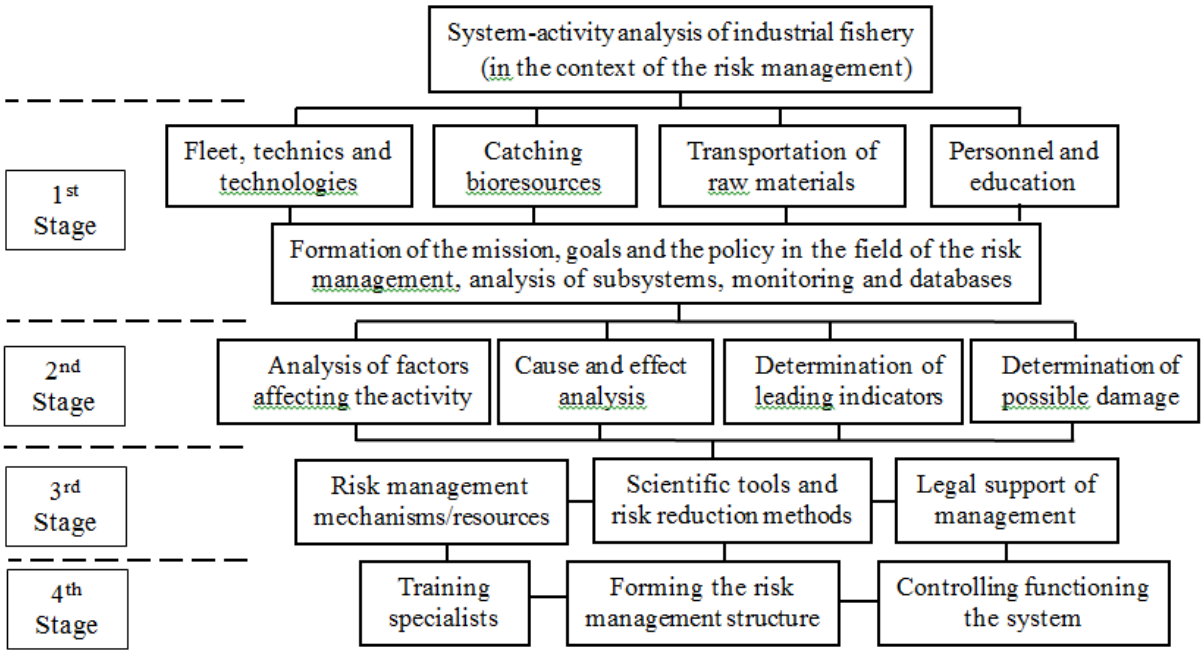

Figure 1. Model of the general concept of the formation of a risk management system in industrial fishery

The methodological basis for designing a risk management system is the system approach. In this regard, first of all, it is necessary to determine which activities and tasks have to be solved in the designed system and by what processes these activities (tasks) will be implemented.

When the design goals and objectives have been defined it is necessary to develop a process model of the future risk management system.

The main tasks of the designed system are: organization of monitoring the fleet work in the context of the its safety; an analysis of the accident rate and determination of the cause-effect relationships; elaborating scenarios for the development of emergency situations based on retrospective data; formation of time series (the statistics on accidents) and the calculation of the expectation/average estimates of the frequency of accidents by type of vessels, seasons, areas; development of plans and the content of advanced training maritime professionals; solving practice-oriented tasks of risk assessment and management; the organization of rescue operations and an advisory assistance to crew of ships in distress (if necessary), etc.

A process model of the risk management system

The solution of practice-oriented tasks of the risk assessment and management includes the following operations [1,3,6,9,10]: identification of risks; assessment of the level and the cost of risk; determination of the acceptable level of the risk; development of measures to reduce the level of risk (if necessary); calculation of the effectiveness and the cost of activities; making management decisions; implementing decisions and its controlling.

Elaborating the process model of the risk management system supposes identifying the main processes that need to "start" realization of the risk management tasks:

– organizational–managerial processes to provide the organization of the implementation of the whole complex of works and the management of the main and auxiliary processes;

– informational processes to collect/systematize data and to provide the system work with the necessary information;

– monitoring processes to provide continuous observation of the fleet operation, collecting information on the accidents rate, the state of the internal and external environment, and registration of parameters of the observed objects, data systematization and evaluation by selected criteria;

– analytical processes to evaluate data and retrospective scenarios on accidents and the impact of factors of the different nature on fishing and transportation of raw materials and identification, calculations, forecasting, assessment, pricing the risks, etc.;

– designing and planning processes to provide organizational and technical measures for safety of vessels, development of projects for fishing/transport-logistic systems for servicing fishing vessels at fishing grounds and planning of trips;

– consulting processes and participating in the organization of rescue operations in cases of accidents and other emergencies;

– educational processes in order to determine the content of training/professional development of specialists [6,7].

An integral part of designing and planning of the fleet operations is the calculation of predictive risk assessments and comparing them with an acceptable level. A project/plan of measures is developed if the prognostic risk estimates exceed or are close to the acceptable level of the risk.

Let us to consider the presented processes in the terms: "an input – a process – an output". The main and auxiliary processes can be selected in any systems. The main processes in the

risk management system are organizational and managerial, that include the risks identification; designing and planning measures for ensuring the safety of a vessel's trip. The auxiliary processes include monitoring, information and analytical processes, financial-economic, including calculations of the risk price and the effectiveness of measures to reduce the level of the risk.

The structure of the adaptive processing model of the risk management is presented in Figure 2. This model reflects the processes and their relationships by means of which the risk management is carried out.

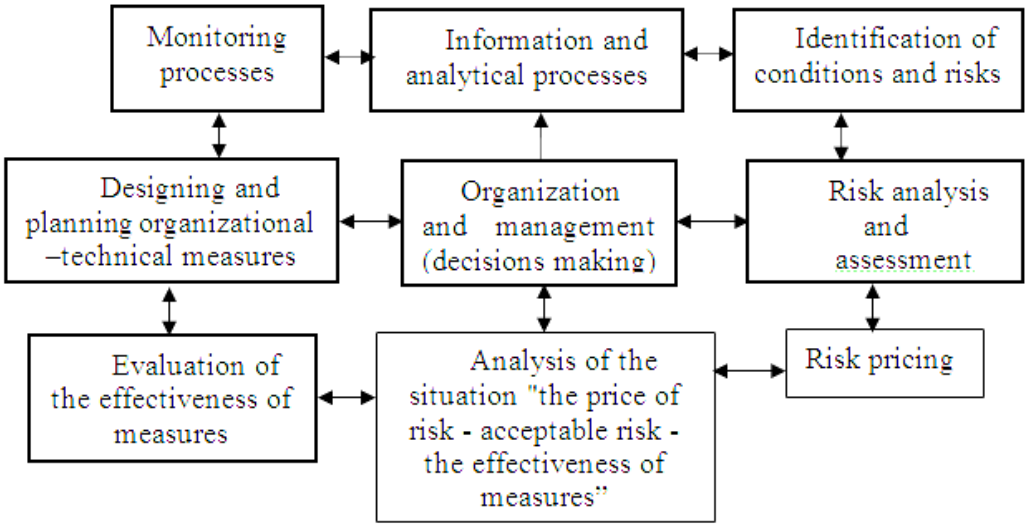

Figure 2. Adaptive process model of the system of assessment and risk management in industrial fishery and transportation of raw materials

The process representation of the management system allows:

– to organize the risk management work without creating additional administrative structures in small fishing and transport companies;

– to create adaptive risk management systems in large fishing and transport companies with a minimum of expenses for maintaining such a specialized structure;

– to create adaptive risk management systems in the central state structures (the Russian Federal Fishing Agency, for example) as well as in specialized regional information–analytical logistic centers.

The main requirement for the designed system can be formulate as the following: the risk management system has to adapt quickly to negative changes of the external environment and prevent such serious consequences of environmental factors as the loss of vessels, accidents, failures of machinery, fishing gear, stopping catching and manufacturing fish products, etc.

The need to take into account changes of the external environment in conditions of the uncertainty leads to the use of adaptive models. An adaptive adjustment of the formal model is made according to the current and predicted information about the input and output variables.

The feature of adaptation is realized in the proposed process model of the risk assessment and management system on the basis of the principles of diversity, duality and feedback.

The diversity principle states that the diversity of the control system should be no less than the diversity of the control object (the control object is the risk in the given case).

The essence of the duality principle is that impossible to carry out effective management without knowing the characteristics of the controlled system/object on the one hand but on the others these characteristics can be studied during the management process and thereby to improve the management quality [6]. These cases the control actions are dual in nature: they are means of both active study, cognition of the controlled system/risks for the future and direct control at the current time [1].

The essence of the feedback principle is that the characteristics of a controlled object are measured and reactions that are expressed as control actions are developed with the help of the feedback [7,11].

An analysis of the structure and characteristics of the process model shown in Figure 2 suggests that the designed model of the risk management system satisfies to all characteristics and principles of the adaptive system. There is the possibility to adapt the risk management system to changing conditions using the basic modules.

Risk indicators

A fishing company is a complex dynamic system that implements many functions. The activities of the company and its fishing and transport vessels can be characterized by many indicators. Each of indicators represents particular information relating to the object of the management. The information presented by various indicators is used to solve various problems. Therefore, it is necessary to separate out the most significant indicators from the array of information in order to solve a different class of problems.

In particular, the following information is needed for risk management tasks:

- technical state of vessels and their operational characteristics;
- frequency of technical equipment failures;
- technical data of the hydroacoustic equipment;

– casualties and fishing accidents;
– characteristics of stability and floodability of vessels;
– crew qualifications;
– hydrological and meteorological characteristics of navigation areas and fishing grounds;
– physical and chemical features of the cargo (for example, fish meal), etc.

An analysis of the dynamics of changes of these indicators, their relationships and sustainability will allow to assess (at least qualitatively) the degree of risk and the presence of risk factors. Thus, indicators containing information about threats to navigation, fishing or other activities are called as “risk indicators”.

The use of the risk indicators has the purpose of informing the company's management about the current situation and possible threats in the foreseeable future. A risk indicator reflects the presence and characterization of a particular risk factor. In this regard the special interest has so called “advanced indicators of risk” i.e. they indicate the presence of risk factors before the occurrence of the risk events.

The effective risk management has to be based on complete and reliable information, the structure and content of which are satisfied to the conditions of minimality and sufficiency.

Formation of the structure of the risk management system

An example of such an organizational structure of the adaptive risk management system (the state structure of the Russian Federation) is demonstrated in Figure 3. The formation of the risk management system structure can be realized in three variants.

The first option is creation the conditionally-permanent risk assessment and management team in the concrete fishing company and supposes:

– the company has at least one highly qualified specialist who is trained in the risk management;
– availability and permanent updating of the database on accidents and risks;
– availability of methods for assessing and managing risks as well as calculating their acceptable level.

The second option means delegating functions of the risk management to an outsourcing structure (for example, to the regional information–analytical logistics centre). This case the company has to:

– get rid of the need to perform complex actions for the risk management, database formation, monitoring, etc.;

– save the cost, because the implementation of certain functions by own staff can be more expensive (for example, the formation of databases);

Internet technologies allow to organize efficiently the execution of relevant functions, as well as remote accessing and transferring of large amounts of data.

The third option is a mixed version of two first options.

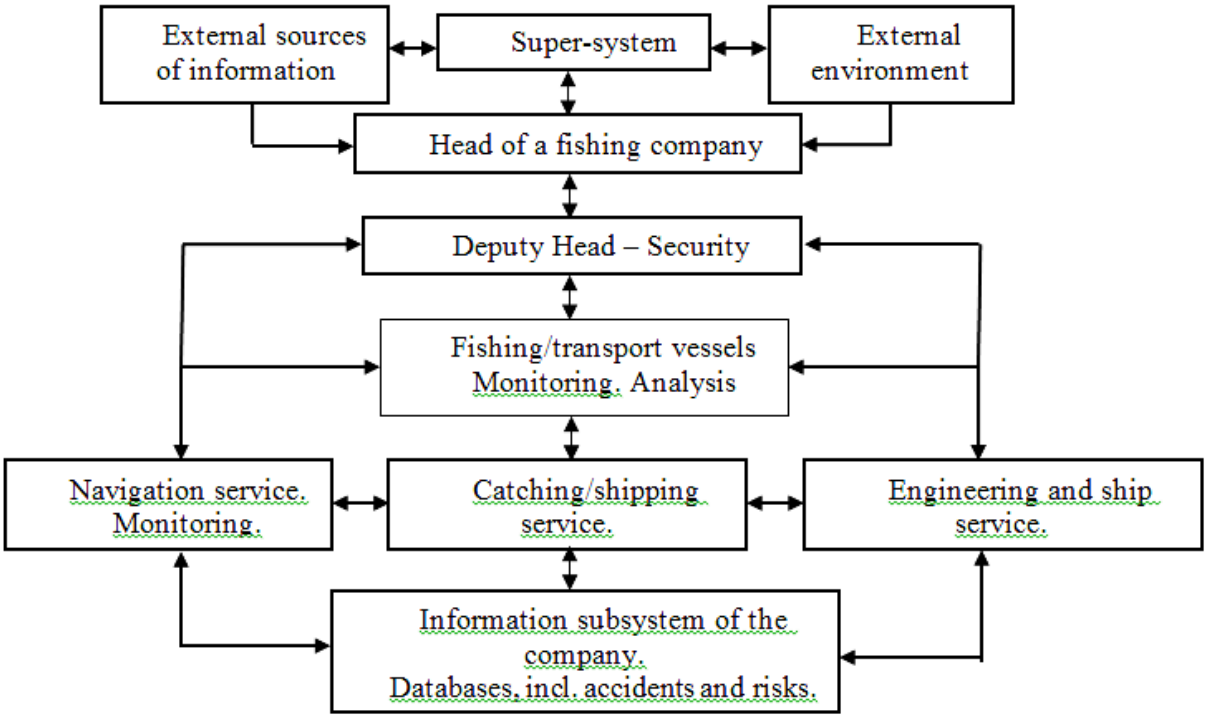

Figure 3. Organizational structure of the risk management system of a fishing company on the principle of conditionally-permanent functional cooperation

The "Super-system" is here the Federal Agency for Fishery is a hierarchically superior management structure that performs the functions of an "ideologist" and a controlling body, on the one hand. On the other hand, the functions of the "Super-system" should include the provision of the methodological and resource assistance to fishing companies in the organization of work on the risk assessment and management.

The "External environment" is the set of objects and entities which can interact directly or indirectly with the fishing company, fishing and transport vessels. The "External environment" can have both positive and negative effects on fishing and transport vessels and companies. The influence of the "External environment" factors should be studied and taken into account for the risk assessment and management. "External sources of information" are

any sources external to the considered object. The information can be very useful for solving both production problems and the navigation safety and the risk management. The head of the fishing company, as the person responsible for the activities of the company as a whole, exercises the general management.

The scheme of functioning of the risk assessment and management system is presented in Figure. 4.

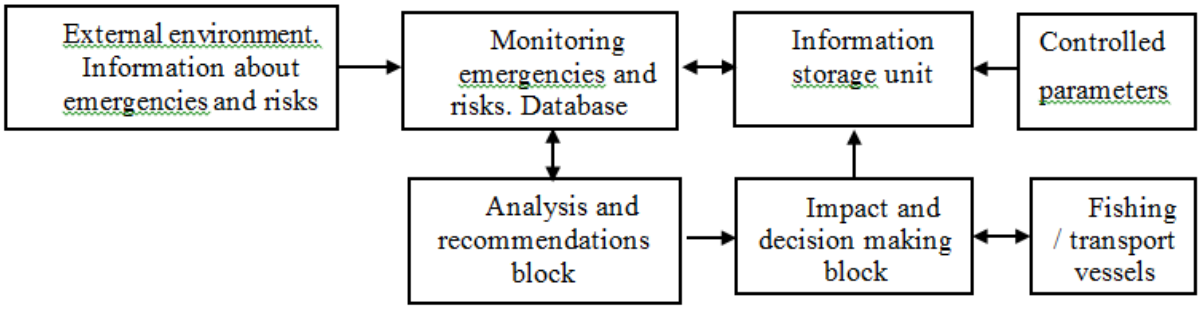

Figure 4. Main elements of the risk management system

Information support of the risk assessment and management system

Information relating to the following types of risks is primarily important in the context of the risk management:

– natural risks which include risks associated with the elemental forces of nature;

– transport risks are risks associated with the carriage of goods by sea transport, in particular navigational risks of vessels collisions, grounding, damages of the propeller-steering group, berths and vessels during mooring, etc.;

– risks of loss/damage of cargo during transportation;

– fishing risks associated with industrial fishery;

– anthropogenic risks;

– ecological risks.

The calculation of probabilistic assessments of the occurrence of emergency situations and the risk realization is based on the use of expert assessments and statistical data on accidents, losses of catch, cargo, causing any damage. In order to use the accident statistics it is necessary to reflect in the investigation of accidents: the type and purpose of the vessel; time and place of the accident/emergency, season and environmental conditions; what actions were taken to avoid and/or reduce damage. As a result, it is necessary to clearly define the chain

“conditions - causes – effect”. It is advisable to describe the scenario of an emergency. Scenario analysis will help to obtain information that will be useful in the future.

Information on accidents and other emergencies will have the greatest practical importance if there is the presence of a representative sample. Data should be differentiated by fishing grounds, navigation areas, types and purpose of vessels, the season. It is necessary to have data on the number of vessels at the fishery or the navigation area to calculate probabilistic risk assessments. It will allows to calculate the frequency or expectation of the occurrence of the emergency/risk.

It becomes necessary to create integrated databases because the sample has to be representative for calculating probabilistic estimates based on retrospective statistical data. Such databases can be created at the level of large fishing companies, regional information and analytical centres, governmental and international structures. At the same time databases of the lower levels has to be integrated into the databases of the upper level. It opens up real opportunities for creating a representative database and using past experience for solving practical problems, studying and researching it and using statistics to calculate probabilistic assessments of risk situations, identifying risk, studying cause-effect relationships, etc.

Conclusion

The risk management in the industrial fishery is closely related to managing the safety of catching, towing fishing gear, interacting with other vessels, transporting raw materials and fish products. The risk management system on the fishing fleet is a set of interrelated processes and operations aimed at achieving a single goal: the risk reduction.

The most important processes and operations in the risk management system are: monitoring fleet operating conditions and risks that occur or may be possible; risk identification; risk analysis; development and planning of measures to eliminate or reduce the level of risks; organization and control over the implementation of measures to eliminate or reduce the level of risks; an analysis of the effectiveness of planned activities and their remote consequences; an analysis of already implemented activities; generating files of positive achievements and negative experiences; a factor analysis of risks based on retrospective data and expert estimates; training specialists for the risk management.

Thus, the risk management system allows fishing companies to predict the occurrence of risks and assess their consequences, to plan transportation taking into account possible risks,

developing measures to reduce risks, to monitor risks at all levels and make rational decisions in case of an emergency.

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COVER LETTER

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Dear Chair of the IAMU AGA2021 Papers Committee,
This letter certifies submitting an original research paper entitled "Methodological Basis for Training Cadets/Professionals and Developing the Risks Management System in Maritime Shipping and Industrial Fishery" for publication in the IAMUC AGA21 proceedings. Authors of the paper study current problems of risk management in maritime shipping and industrial fishery working in the Baltic Fishing Fleet State Academy of the Kaliningrad State Technical University.
Authors confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere. We have no conflicts of interest to disclose and agree that the manuscript will be formally refereed.
Please address all correspondence concerning this paper to me as the corresponding author at e-mail address: meyler.le@bgarf.ru
Thank you for consideration of this paper.

Sincerely,
Prof. Leonid Meyler

The brief biography of the presenting author:
Leonid Meyler has a PhD in Technical Sciences and is Head of the Transport Organization Department of BFFSA KSTU.
He graduated from the Kaliningrad Technical Institute of Fishing Industry having received the qualification "Engineer on naval architecture". Long time he worked in the Scientific-production Corporation on industrial fishery. He took an active part in designing, creating and developing methods for experimental research on fishing gear.
In 1994-1995 he worked in IFREMER (France).
He works in BFFSA since 1998. He is the author/co-author of more than 100 scientific and educational publications in Russian and foreign journals and proceedings of many scientific conferences. The main areas of scientific interests are: hydrodynamics of industrial fishing gear, professional education of transport specialists, and development of transport and logistics systems.