

**“KROK” UNIVERSITY**

**Educational and Scientific Institute of Management and Adult Education**

**Department of Management Technologies**

**Thomas Uwemedimo**

**UDC: 005.334**

**THESIS**

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\_\_\_\_\_ Thomas Uwemedimo

(signature, initials and surname of the applicant)

Scientific Supervisor (consultant) Olena Naumova

PhD (in Economics), associate professor

(full name, scientific degree, academic title)

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## INTRODUCTION

Risk is an integral part of human activity related to decision-making, including in the financial and economic field. Despite the fact that the chosen topic is quite popular, for example, the following authors were engaged in a similar problem: E. D. Solozhentsev, I. A. Blank, N.V. Khokhlov, A.N. Asaul, I. P. Knyaz, Yu. V. Korotaeva, but mainly the risk is assessed by these authors within the framework of a statistical approach. The need to diagnose the level of risk and its correction is dictated by the aim of increasing financial reliability. The very concept of "financial risk" is defined ambiguously due to the fact that it is formulated by scientists from different fields. For example, for A. P. Algin: financial risk is an activity associated with overcoming uncertainty in a situation of inevitable choice, during which it is possible to quantitatively and qualitatively assess the likelihood of achieving the expected result, failure and deviation from the goal [1]. Thus, to determine the level of financial stability, such an indicator as the financial risk ratio is used, which determines the ratio of attracted resources and equity capital.

Nevertheless, the statistical approach does not always allow us to assess the risk with a sufficiently high accuracy, but with a competent analysis of all factors, it is possible to increase the accuracy of predicting the level of risk and the reasons for its occurrence, which will avoid unwanted financial losses, and possibly even profit by attracting an optimization approach. to the solution of this problem. Thus, the chosen topic is relevant and this work proposes the development of new mathematical modeling methods in relation to financial risks in H-art consulting within the framework of the optimization approach. However, at present, there is also no universal method suitable for solving all problems of recognition, identification and diagnostics. Interest in

optimization methods has intensified in recent years, since the current level of development of computer technology makes it possible to implement many methods and algorithms that previously could not be used due to the processing of huge arrays of experimental data.

Statistical and optimization approaches to solving problems of mathematical diagnostics successfully complement each other: processing the same databases using both approaches allows obtaining more reliable information and provides the decision maker with the opportunity to choose the most rational solution.

Thus, the aim of the study is to build a new mathematical model that allows you to get more accurate results when assessing financial risk. To achieve this goal, the following tasks will be solved: the task of ranking parameters using a statistical approach, namely, using the Fisher criterion, and the task of classifying the client database in terms of solvency risk.

Many conditions and factors affect the outcome of decisions made by people, the action of some of them is very difficult to predict, many decisions have to be made in conditions of uncertainty.

Risk is inherent in almost every area of human activity. Most often, risks are associated with force majeure or financial collapse. But the emergence of a new competitor or a promising technology on the market, a change in consumer preferences are also risks, and no less dangerous.

The relevance of the topic of this thesis is determined by the fact that at present there are a huge number of types of risks, which are different for each individual enterprise and manufacturer. The ability to effectively influence risks makes it possible for an enterprise to function successfully, have financial stability, high competitiveness and stable profits. This necessitates analysis, accounting, forecasting and risk management, the ability to take potential threats under control and turn them into new opportunities for the company. The most successful will be

the activity of a company that has correctly calculated its capabilities, has chosen a direction of activity with an optimal ratio of risk and profitability.

Any business (economic activity) is risky. Real estate activity (business) is no exception. The real estate business is accompanied by a considerable number of various risks. With the manifestation of the global financial and economic crisis in 2008, many real estate agencies simply disappeared due to a decrease in purchasing power for expensive goods, which include real estate. Banks stopped lending to the population, the population stopped buying apartments on mortgage.

Demand for real estate has fallen, most realtors are no longer needed in the volume in which they were present on the market before the crisis. At the moment, the real estate market is witnessing a real growth of transactions, albeit in a very small number, but the dynamics remains positive. This speaks of an increase in the purchasing power of the population, of the interest that people began to show to noticeably cheaper real estate and that a number of large banks nevertheless launched a small number of programs for lending to the population, began to give mortgage loans at a lower interest rate. But the risks have not disappeared anywhere: unforeseen political events, economic shocks and natural disasters, environmental disasters, changes in the situation in the market as a whole, prices, demand, profit levels, economic fluctuations, changes in the taste of customers and the risk of losing a customer, the actions of competitors and others.

In comparison with the West in the Russian economy, where the factors of economic instability already complicate the effective management of enterprises, insufficient attention is paid to the problems of analyzing and managing the complex of risks arising in the course of their economic activities. This is due to the imperfection of the legislative and regulatory framework, lack of personal experience in this area of management.

Real estate transactions are among the most risky business sectors. The reason for this lies mainly in the peculiarities of the real estate market, such as locality, high dependence on the state of the regional economy, long-term nature of investments, and low liquidity of goods on the market. Also, such circumstances as the significant level of costs of real estate transactions, and the high capital intensity of real estate objects put the problem of risk management at one of the first places in business in the real estate market.

Based on the above, the purpose of writing this thesis is to disclose the content of the enterprise risk management problem, analyze the existing risks at the enterprise (Expert Real Estate LLC), and develop a mechanism for enterprise risk management in modern economic conditions. The stated goal of the study predetermined the need to formulate and solve a number of interrelated tasks:

- study the theoretical aspects of risk management;
- to study methodological approaches in the theory of risk management at the enterprise;
- to analyze the existing risks and the risk management methodology at the LLC "Expert-real estate";
- to develop a set of measures for risk management at the enterprise LLC "Expert-real estate", as well as a set of methods used to minimize the risks existing at the enterprise;
- calculate the economic effect and efficiency from the implementation of the proposed measures.

The object of the research of this work is the real estate agency "Expert-real estate".

The subject of the research is the economic relations and patterns that influence the formation of the risk management mechanism at the enterprise. LLC Expert Real Estate.

The practical significance of the thesis consists in identifying the existing risks in this industry, their impact on similar enterprises in the industry, as well as coordinated and systematic risk management at the LLC Expert Real Estate.

The methodological basis of my research was formed by the concepts and views of domestic and foreign economists, journal articles, materials of scientific seminars and conferences related to risk problems. The analysis of the scientific literature I have studied indicates that the problem of enterprise risk management has been reflected to one degree or another in a relatively small number of scientific works. Therefore, when assessing real estate objects, built-up and undeveloped land plots, the methodology of analysis and risk assessment is still rarely used.

The legal basis for my research was: the Civil Code of the Russian Federation and the laws governing the activities of Expert-Real Estate LLC, as well as Russian standards in the field of risk management. These standards consolidate the importance of risk management as an obligatory component of the effectiveness of an investment project, reflect the fundamentals of the risk management concept and describe risk management as “the systematic application of policies, procedures and management methods to the tasks of determining the situation, identifying, analyzing, assessing, processing, monitoring risk and sharing risk-related information to reduce losses and increase profitability. ”

## About H-art

**H-ART** is a consulting company headquartered in Kyiv, which provides personnel audit and management consulting services, as well as training for managers. Since 2007, the company's specialists have successfully implemented more than 109 consulting projects, and more than 1,060 managers and business owners have taken practical courses.

## Benefits

- Introduction of practical tools successfully implemented in more than 60 companies of Ukraine and CIS countries.
- Individual approach to each project, problems and ways to solve it.
- Focus on measurable results in money from the implementation of consulting solutions.
- Practical management experience in leading Ukrainian consulting companies "H-ART".

## Specialization

H-ART specializes in implementing an effective management system in retail, manufacturing, industrial and commercial enterprises, which allows companies to increase income and profitability in a short time, and owners to move from "manual" management to remote control of self-developing business, including:

- Business consulting - development and implementation of a set of steps to modernize the company's current business processes in order to increase the main financial performance of the enterprise and increase business efficiency and productivity.
- Personnel audit services - selection and evaluation of candidates, as well as staff, assessment of the current human resources of the company,

development of an applied system of motivation. It is also possible to provide comprehensive personnel consulting services for your business.

## CHAPTER 1 GENERAL RISK THEORY

### 1.1 Essence, content and types of risks

Risk is an inherent characteristic of any human activity. At the end of the 20th century, humanity began to enter the risk society, which is characterized by increasing openness, nonlinear and self-organizing development. In the late 90s. financial institutions around the world have been actively implementing market risk management systems. In Russia, this happened with some delay, but no less actively. But after the 1998 crisis, most banks curtailed their operations in the securities market, and the market itself practically ceased to exist. Along with it, market risks have disappeared, and, accordingly, the need for systems to manage them. Today, in the context of the global financial and economic crisis, risk management is considered a priority. Risks in modern business are a constant process. Only the one can win who knows how to manage them in a crisis. However, the specificity of the Russian market requires building its own set of risk factors, which makes it difficult to use ready-made Western solutions for assessing risks, they are often simply not used.

There is a wide variety of opinions about the concept of definition, essence and nature of risk. This is due to the multidimensionality of this phenomenon, insufficient use in real activities, ignorance in the existing legislation. The main research on various aspects of risk began in the late 19th century. There are two points of view regarding the development of domestic science in the field of studying "risks" at that time. Supporters of the first believe that at that time there were no scientific and practical developments in this area [8]. They argue their opinion by the fact that, firstly, the administrative methods of managing the

socialist economy did not imply the use of the concept of "risk" as an economic category, which excluded the need for any research in this area. Secondly, any attempts to find elements of risk in the activities of enterprises were qualified as attempts to doubt the correctness of socialist economic theory, which, of course, was suppressed by the most cruel means. According to the second point of view, the problem of risks at that time was not completely new for Russian scientists. This is due to the fact that research in the field of risks was carried out in the USSR, but they were one-sided and did not take into account most of the risks faced by an economic entity in its activities. The economic reform in the 1990s in Russia aroused interest in the issues of considering risks in economic activity, and the theory of risk itself in the process of the formation of market relations not only received its further development, but became practically in demand.

The term "risk" came to the Russian language from European languages. This concept most likely developed in the language of sailors. To take risks literally meant to maneuver between the rocks. [16] And it is marine insurance that can be considered the first example of systematic risk management. In the West, the problem of risk management is the most studied. There are both theoretical fundamental works that reveal the essence and content of the concept of "risk", "risk assessment", "risk management", and practical guidelines and publications of a popular scientific nature. [18] In Russia, more in-depth research in this area is limited only to entrepreneurial and commercial risks.

Analysis of modern works devoted to the problems of risk allows us to assert that risk is a complex phenomenon that has many different, sometimes contradictory real components. Risk has a subjective-objective nature, which is determined by the fact that it is generated by processes of both a subjective nature and those whose existence, ultimately, does not depend on the will and consciousness of a person. By their nature, risk is divided into three types [52]:

1. When at the disposal of a subject making a choice from several alternatives, there are objective probabilities of obtaining the intended result. These are probabilities that do not directly depend on a given firm: inflation rate, competition, statistical studies, etc.
2. When the probabilities of the expected result can be obtained only on the basis of subjective assessments, i.e. the subject deals with subjective probabilities. Subject probabilities directly characterize a given firm: production potential, level of subject and technological specialization, labor organization, etc.
3. When the subject in the process of choosing and implementing an alternative has both objective and subjective probabilities.

Thanks to these modifications of risk, the subject makes a choice and strives to realize it. As a result, the risk exists both at the stage of choosing a solution and at the stage of its implementation.

Consider two concepts that complement each other and cover the general content of risk. The first definition is that the risk is defined as the likelihood (threat) of the enterprise losing part of its resources, loss of income or the appearance of additional costs as a result of certain production and financial activities. [2] Therefore, the risk refers to the possible danger of losses, is considered as a situational characteristic of the activity, consisting in the uncertainty of its outcome and possible adverse consequences in cases of failure. From the Greek language "risk" is translated as "cliff, rock", from Italian "danger, threat", from French "threat, take risks, go around a cliff, rock". This interpretation of this concept is also seen in the works of many Russian scientists and writers. For example, in the dictionaries of Webster, Ozhegov, Dahl, "risk" "means any opportunity for an individual or a team, a possible danger of loss, a situational characteristic of an activity, consisting in the uncertainty of its outcome and possible adverse consequences in cases of failure." [3] Also A. Varechkina and S. Taran consider

the risk as the possibility of some adverse event occurring, entailing various kinds of losses. [four]entailing various kinds of losses. [four]entailing various kinds of losses. [four]

The second definition of risk is associated with the concept of "risk situation". A situation, in general, is a combination, a set of various circumstances and conditions that create a certain environment for a particular type of activity. The environment can facilitate or hinder the implementation of this action. In a risk situation, it is possible to quantitatively and qualitatively determine the degree of probability of a particular option, and it is accompanied by three conditions:

- the presence of uncertainty;
- the need to choose an alternative (including refusal to choose);
- the ability to assess the likelihood of the implementation of the selected alternatives.

There are a number of proponents of this definition of "risk". For example, Fedotov D.K. risk is understood as the probability of an event occurring and its expected impact on the company's activities, as well as the uncertainty of financial results in the future. [5] Rogov M.A. defines risk as the possibility of non-occurrence of any expected events, the possibility of deviation of any values from some of their expected values. [6]

In reality, the financial and economic activities of the enterprise are carried out in conditions of uncertainty. The choice of this or that development strategy can lead to both the increase and the loss of the invested funds. In the face of uncertainty, there are always many alternative decision-making options. The likelihood of successful implementation, that is, obtaining maximum income with a minimum of losses, of any of them depends on a significant number of internal and external factors affecting the enterprise. These realities fully reveal the essence and concept of risk.

Based on the essence and concept of risk, there are two risk theories: classical and neoclassical. In the classical theory of economic risk, J. Mill and N.W. Senior risk is understood as damage that is caused as a result of deviations from the chosen decision and strategy of activity. Economists A. Marshall and A. Pigou in the 30s of the XX century developed the foundations of the neoclassical theory of economic risk. Here, risk is defined as the likelihood of deviations from the set goals. Proponents of this theory note that "... the actions of an entrepreneur are conditioned by the concept of marginal benefit, that is, with the same amount of potential profit, the entrepreneur chooses an option associated with a lower level of risk. An entrepreneur can take great risks if the expected profit from his actions is greater. " [7]

Thus, we can conclude that the risk is based on the probabilistic nature of market activity and the uncertainty of the situation, and the risk is a two-dimensional value that characterizes the probability and amount of losses caused by uncertainty associated with the activities of the organization.

The main features of risk include: inconsistency, alternativeness and uncertainty. [8] Such a feature as inconsistency in risk leads to a clash of objectively existing risky actions with their subjective assessment. Since along with initiatives, innovative ideas, the introduction of new promising activities that accelerate technological progress and affect public opinion and the spiritual atmosphere of society, there are conservatism, dogmatism, subjectivity, etc. Alternativeity implies the need to choose from two or more possible options for decisions, directions, actions. If there is no choice, then there is no risky situation, and, consequently, no risk. Uncertainty is the incompleteness or inaccuracy of information about the conditions for the implementation of a project (solution). The existence of risk is directly related to the presence of uncertainty, which is heterogeneous in its form of manifestation and content. Entrepreneurial activity is carried out under the influence of the uncertainty of the external environment (economic, political,

social, etc.), many variables, counterparties, persons whose behavior cannot always be predicted with acceptable accuracy. Based on this, the following main reasons for uncertainty (risk) can be identified: the following main reasons for uncertainty (risk) can be identified: the following main reasons for uncertainty (risk) can be identified:

- spontaneity of natural processes and phenomena, natural disasters;
- randomness, when in similar conditions the same event occurs differently as a result of many socio-economic and technological processes;
- the presence of opposing tendencies, clash of interests: military actions, interethnic conflicts;
- the probabilistic nature of scientific and technological progress. It is practically impossible to determine the specific consequences of certain scientific discoveries, technical inventions;
- incompleteness, insufficient information about an object, process, phenomenon. This reason leads to the limitation of a person in the collection and processing of information, with the constant variability of this information;
- limited material, financial, labor and other resources when making and implementing decisions; the impossibility of unambiguous cognition of the object at the prevailing level and methods of scientific knowledge; limited conscious human activity, existing differences in socio-psychological attitudes, assessments, behavior.

Since the risk is a complex subject-object system, there is a need for its decomposition according to various criteria. The classification of risks predetermines the effectiveness of the organization of their management. Risk classification should be understood as the distribution of risk into specific groups according to certain criteria in order to achieve the set goals. Scientifically based

risk classification makes it possible to clearly define the place of each risk in their overall system. Risk classification helps [9]:

- compile the most complete list of risks inherent in the company's business;
- choose the most suitable control method for each of them;
- to optimally organize the company's risk management system.

Risk classification means the systematization of a set of risks based on some signs and criteria that allow you to combine subsets of risks into more general concepts. The search for optimal criteria is still being dealt with. So, one of the first to classify risks was J.M. Keynes. He approached this issue from the side of an entity carrying out investment activities, highlighting three main types of risks [8]:

- entrepreneurial risk - the uncertainty of obtaining the expected income from investment;
- “lender” risk - the risk of non-repayment of a loan, which includes legal risk (evasion of loan repayment) and credit risk (insufficient collateral);
- the risk of a change in the value of a monetary unit - the probability of loss of funds as a result of a change in the exchange rate of the national monetary unit (market risk).

At the moment, almost every book devoted to risk issues provides one of the options for classifying risks. In most cases, the selected criteria do not allow covering the entire set of risks, however, a number of main risks appear in the economic literature. Based on this, attempts to classify subsets of risks included in these general concepts are quite frequent.

Also L. Antonyan in his article relies on one of the many classifications of risks that have developed abroad. It was compiled by the International Association of

Risk Management Professionals in the document "Generally Accepted Risk Principles" [50] ("Generally Accepted Principles of Risk Management"), where risks are divided into the following types [9]:

- credit risk (non-compliance with obligations);
- market risk (changes in market factors: prices, exchange rates, interest rates);
- portfolio concentration risk (on one product, segment, financial instrument);
- liquidity risk (inability to fulfill current obligations);
- operational risk (a set of adverse events, starting with technological failures and ending with personnel errors, fraud);
- the risk of a business event (for example, an unsuccessful merger with another company or an incorrect marketing assessment of market demand).

Other classification options:

- by the nature of the consequences: net (only losses), speculative (losses or unplanned profit);
- by the scale of the consequences: minor, permissible, critical, catastrophic;
- by the frequency of implementation: small, medium, high;
- at the place of appearance: internal, external (in relation to the managed object);
- by the level of occurrence: a separate workplace or employee, a structural unit, an enterprise as a whole, an industry or a group of related industries, a region, a country as a whole, global risks;

- by sphere of origin: natural-ecological, demographic, geopolitical, socio-political, administrative-legislative, industrial, commercial, financial, innovative;
- for reasons of occurrence: uncertainty of the future, lack of information, subjective factors;
- by the nature of objects at risk: property, income, life and health of people, civil liability, etc.

Thus, it is clear that there is no clearly defined risk classification. Moreover, there are more than 40 different risk criteria and more than 220 types of risks, so there is no common understanding in the economic literature on this issue. Nevertheless, the risk theory allows us to identify the most general risk groups [8]:

1. Organizational risks. This item can include the risks associated with the mistakes of the company's management, its employees; problems of the internal control system, poorly developed work rules and others, that is, risks associated with the internal organization of the company's work.
2. Market risks. These are the risks associated with the instability of the economic environment: the risk of financial losses due to changes in the price of goods, the risk of a decrease in demand for products, translational currency risk, the risk of losing liquidity, etc.
3. Credit risks. The risk that the counterparty will not fulfill its obligations on time. These risks exist both for banks (the classic risk of loan defaults) and for enterprises with receivables and organizations operating in the securities market.
4. Legal risks. These are the risks of losses associated with the fact that the legislation was either not taken into account at all, or changed during the period of the transaction; the risk of inconsistency with the laws of different countries; the risk of incorrectly drawn up documentation, as a result of

which the counterparty is in a position not to fulfill the terms of the contract, etc.

5. Technical and production risks. Technical and production risks - the risk of damage to the environment (environmental risk); the risk of accidents, fires, breakdowns; the risk of disruption to the functioning of the facility due to errors in design and installation, a number of construction risks, etc.

To one degree or another, these risks are present in the activities of all economic entities. This basic classification is complemented by private classifications based on the specifics of economic entities.

Regional - characterizes the features of the region in which the financial and economic activities of the enterprise are planned or are already being carried out.

Natural-natural - due to the negative influence of the elemental forces of nature.

Political - characterizes the possibility of changing the socio-political climate in the country and the region, as well as development prospects.

Legislative - due to the possibility of a sharp change in various legislative acts affecting the financial and economic activities of the enterprise.

Transport - characterizes the likelihood of loss of assets (property, equipment, etc.) during transportation or transportation.

Organizational - due to internal factors operating within the company. Such factors can be the firm's strategy, business principles, resources and their use, quality and level of use of management and marketing.

Property - characterizes the degree of probability of loss of property due to theft, sabotage, negligence, etc.

Personal - arises when the final results of financial and economic activities depend on a particular person, his business and moral qualities. This type of risk is especially relevant when making serious decisions, when concluding contracts, performing special tasks, when selecting a leader and forming working groups.

Marketing - characterizes the market conditions (demand, supply, prices) in which the financial and economic activities of the enterprise are carried out.

Production - due to the development of new equipment, technology and the implementation of production activities.

Estimated - characterizes the likelihood of financial losses as a result of an incorrectly chosen moment, form and term of payment.

Investment - due to the choice of capital investment in order to obtain economic benefits over a certain period of time.

Currency - characterizes the impact of changes in the exchange rate on the financial and economic activities of the enterprise.

Credit - characterizes the generalized concept of all risks associated with the process of assessing the borrower.

Financial - characterizes the analysis of the financial and economic activities of the enterprise based on the data of the financial statements.

Particular attention should be paid to the analysis of financial risks in H-art consulting accompanying the company, since financial risks in H-art consulting are present in almost all real estate transactions, and ignoring them can lead to bankruptcy and liquidation of the company.

Financial risks in H-art consulting are associated with the likelihood of loss of financial resources, that is, cash. Financial risks in H-art consulting at an enterprise

are closely related to making management decisions in an uncertain external business environment. To improve the efficiency of functioning, modern enterprises are forced to build an efficient and reliable financial risk management system at the enterprise. Financial risk management is based on purposeful search and organization of work to reduce the degree of risk, gain and increase profits in a rapidly changing and uncertain economic situation. The ultimate goal towards which the procedure for managing the financial risks in H-art consulting of an enterprise is consistent with the target function of entrepreneurship. It consists in obtaining the maximum profit with the minimum, or at least, an acceptable ratio of profit and risk for an entrepreneur. Such a problem in a modern enterprise is solved by risk management, which is a system for managing risk and economic, more precisely, financial relations arising in the process of this management. If we consider financial risk management (risk management) as a system, then it includes two subsystems: controlled (controlled object) and manager (controlled subject). The object of management in risk management is directly the risk itself, risky financial transactions associated with investment, and economic relations between business entities. Such relationships include the relationship between the policyholder and the insurer, the borrower and the lender, between partners and competitors, and others. The subject of management in the structure of financial risk management of an enterprise is a special group of people (financial manager, insurance specialist, acquirer, actuary, underwriter, etc.), which, using various techniques, carries out the purposeful functioning of management objects that fall under the category of financial risks.

Financial risks in H-art consulting play the most significant role in a firm's overall entrepreneurial risk portfolio. The increase in the degree of influence of financial risks in H-art consulting not only on the financial results of the firm, but also on the results of production and economic activities in general, is associated with the rapid volatility of the economic situation and financial market conditions, the

expansion of the sphere of financial relations of the firm, the emergence of new financial technologies and instruments for Russian firms other factors.

Financial risks in H-art consulting are objectively based due to the uncertainty of the external environment in relation to the organization. The external environment includes the objective economic, social and political conditions within which the firm carries out its activities and to the dynamics of which it is forced to adapt. The uncertainty of the external environment is predetermined by the fact that it depends on many variables, counterparties and persons, whose behavior cannot always be predicted with acceptable accuracy. Thus, the objectivity of financial risks in H-art consulting is associated with the presence of factors, the existence of which, ultimately, does not depend on the activities of the firm. On the other hand, financial risks in H-art consulting also have a subjective basis, since they are always realized through a person. Since it is the entrepreneur who assesses the risk situation, generates many possible outcomes and makes a choice from many alternatives. In addition, the perception of risk depends on each individual person with his character, mentality, psychological characteristics, level of knowledge and experience in his field of activity. Financial risks in H-art consulting are, on the one hand, the danger of a potentially possible, probable loss of resources or shortfall in income compared to the option that is designed for the rational use of resources in a given field of activity, on the other hand, it is the likelihood of obtaining additional profit associated with the risk. Thus, financial risks in H-art consulting belong to the group of speculative risks, which, as a result of their occurrence, can lead to both losses and gains. [10]the perception of risk depends on each individual person with his character, mentality, psychological characteristics, level of knowledge and experience in his field of activity. Financial risks in H-art consulting are, on the one hand, the danger of a potentially possible, probable loss of resources or a shortfall in income compared to the option that is designed for the rational use of resources in a given field of activity, on the other hand, it is the likelihood of obtaining an additional amount of profit associated with the risk.

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Financial risks in H-art consulting are characterized by a great variety, and in order to effectively manage them, it is advisable to classify them according to various criteria:

1. Whenever possible, insurance financial risks in H-art consulting are divided into two large groups in accordance with the possibility of insurance: insured, non-insured. The organization can partially shift the risk to other objects of the economy, in particular, to protect itself by making certain

costs in the form of insurance premiums. Thus, a firm can insure some types of financial risks. The insured risk is a probable event or a set of events, in the event of which the insurance is carried out. The classification of types of insurance activities defines financial risk insurance as insurance that provides for the obligations of the insurer for insurance payments in the amount of full or partial compensation for loss of income (additional costs) caused by the following events:

- production interruption or production reduction as a result of specified events;
- bankruptcy;
- Unexpected expenses;
- non-fulfillment (improper fulfillment) of contractual obligations by the counterparty of the insured person who is the creditor of the transaction;
- legal expenses incurred by the insured person and other events.

However, there is a group of financial risks in H-art consulting that companies do not undertake to insure, but often it is the uninsured risks that are potential sources of additional profit for the company. But losses as a result of the occurrence of insured risk are reimbursed only from the firm's own funds.

2. By the level of financial losses: acceptable risk, critical risk, catastrophic risk.

Acceptable financial risk is the threat of full or partial loss of profit from the implementation of a particular financial project or from the financial activities of the company as a whole. In this case, losses are possible, but their size is less than the expected profit. Thus, this type of financial activity or a specific financial transaction, despite the likelihood of risk, retain its economic viability.

The next degree of risk, more dangerous in comparison with the acceptable one, is critical risk. This type of financial risk is associated with the risk of losses in the

amount of the costs incurred for the implementation of a specific financial transaction or type of financial activity. At the same time, the critical risk of the first degree is associated with the threat of obtaining zero income, but with the reimbursement of material costs incurred by the entrepreneurial firm. Critical risk of the second degree is associated with the possibility of losses in the amount of full costs, i.e. loss of the intended revenue is likely and the firm has to reimburse costs from other sources.

Catastrophic risk is characterized by the fact that financial losses on it are determined by the partial or complete loss of the property state of the entrepreneurial firm. Catastrophic risk, as a rule, leads to the bankruptcy of the company, since in this case it is possible to lose not only all funds invested in a certain type of financial activity or a specific financial transaction, but also the property of the company. To a greater extent, this is typical for a situation when the firm received external loans against the expected profit; when a catastrophic financial risk arises, the firm has to repay loans from its own funds.

3. According to the area of occurrence, financial risks in H-art consulting can be divided into external and internal.

The source of external risks is the external environment in relation to the firm, that is, it is a risk that does not depend on the activities of the firm. The organization cannot influence external financial risks, it can only anticipate and take them into account in its activities. This type of risk is typical for all participants in financial activities and all types of financial transactions. External financial risks in H-art consulting arise when certain stages of the business cycle change, the financial market conditions change, as a result of unforeseen changes in the legislation in the field of the company's financial activities, as a result of the instability of the political regime in the country of operation and in a number of other similar cases that the company can influence in the course of its activities. cannot. This group of

financial risks in H-art consulting includes inflationary, currency, interest rate and other risks.

Internal financial risks in H-art consulting are risks that depend on the activities of a specific entrepreneurial firm, that is, their source is the firm itself. These risks may be due to:

- unskilled financial management at the firm;
- ineffective structure of the firm's assets;
- excessive commitment of the company's management to risky financial transactions;
- incorrect assessment of business partners;
- the unstable financial position of the company and other similar factors.

The organization can largely prevent the negative consequences of internal financial risks in H-art consulting through effective financial risk management, that is, a decrease in the overall level of the company's financial risks in H-art consulting is achieved by reducing the internal risks.

4. Whenever possible, foreseeable financial risks in H-art consulting are divided into the following two groups: predictable and unpredictable.

Forecasted financial risks in H-art consulting are risks, the occurrence of which is a consequence of the cyclical development of the economy, changing stages of the financial market conjuncture, predictable development of competition, etc. The predictability of financial risks in H-art consulting is relative, since if the occurrence of an event can be predicted with one hundred percent probability, then it is impossible to talk about risk in this case, since this excludes the event in question from the risk category.

5. By the duration of exposure, on the basis of which two risk groups are distinguished: permanent financial risk and temporary financial risk.

Constant financial risk is characteristic for the entire period of a financial transaction or financial activity and is associated with the action of constant factors. Thus, permanent risks include those risks that continuously threaten the activities of a firm in a given geographic area or in a particular sector of the economy. This group of financial risks in H-art consulting includes currency and interest rate risks.

Temporary financial risk is of a temporary nature; the company faces this type of risk only at certain stages of a financial transaction or financial activity. Temporary financial risks, in turn, can be divided into two groups: short-term and long-term risks. Short-term risks include those risks that may arise during a finite known period of time, for example, credit and investment risk, and the duration of the possible action of long-term risks is quite difficult to estimate reliably, for example, inflation risk.

6. According to the possible consequences, financial risks in H-art consulting are divided into three groups:

- the risk, as a result of which the entrepreneurial firm incurs economic losses, that is, when this risk occurs, the financial consequences can only be negative (loss of income or capital of the firm);
- the risk, as a result of which the entrepreneurial firm does not receive a certain amount of income, which it was counting on, that is, in this case we are talking about lost profits or lost profits. This risk characterizes a situation when a company, due to the existing objective and subjective reasons, cannot carry out the planned financial operation.

- the risk, as a result of the occurrence of which the company can count on both receiving additional income and the occurrence of economic losses. This type of risk is most often characteristic of speculative financial transactions, but it can also arise in other situations, for example, the risk of implementing a real investment project, the profitability of which at the stage of operation can be both lower and higher than the calculated level of profitability.

7. According to the object of risk occurrence, three groups of financial risks in H-art consulting can also be distinguished:

- risks of individual financial transactions carried out by an entrepreneurial firm;
- risks of various types of financial activities of the company;
- the risks of the financial activities of the company as a whole.

Risks of an individual financial transaction characterize in a complex all financial risks in H-art consulting that a company may face when carrying out any financial transaction.

Risks of various types of financial activities are all financial risks in H-art consulting that may arise in the course of carrying out any type of financial activity (the investment activity of a firm is characterized by a portfolio of various investment risks).

Risks of the financial activities of the company as a whole include a set of various financial risks in H-art consulting that may arise in the implementation of financial activities by the company. These risks depend on the organizational and legal form of the company, on the structure of its capital and assets, and other factors.

8. If possible, further classification distinguishes between simple and complex financial risks.

Simple financial risks in H-art consulting are risks that cannot be divided into separate subtypes, for example, inflationary risk, which is not subject to further classification.

Complex financial risks in H-art consulting are risks that include a complex of its various subspecies. This group of financial risks in H-art consulting includes investment risk, which is further classified into many subspecies.

In addition to the listed signs of the classification of financial risks, there is also a classification of risks into the following types:

1. Inflation risk is a type of financial risk, which consists in the possibility of depreciation of the real cost of capital (in the form of a firm's financial assets), as well as the expected income and profit of a firm from financial transactions or operations due to inflation. This type of risk is permanent and accompanies all financial transactions of an enterprise in an inflationary economy. Thus, inflationary risk stands out as an independent type of financial risk only in an inflationary economy.
2. Tax risk. It represents the probability of losses that an entrepreneurial firm may incur as a result of market changes in tax legislation or as a result of errors made by the firm in calculating tax payments. Thus, the tax risk simultaneously belongs to both the group of external financial risks in H-art consulting and the group of internal risks. Tax risk includes:
  - the likelihood of additional payments to the budget as a result of an unplanned increase in tax rates;
  - the likelihood of losses as a result of the adoption of decisions by the tax service that reduce tax benefits, that is, early cancellation of the provided tax benefits;
  - a significant increase in arrears on payments to the budget, which entails not only penalties, but also the threat of the tax police stopping the activities of the

company, seizing its accounts, seizing documents related to the economic activities of the company, etc.

- the likelihood of losses as a result of tax errors committed through the fault of the employees of the accounting department of the company.

All this, ultimately, can lead to the liquidation of the organization. Errors in tax calculations are punishable by impressive financial sanctions. At the same time, quite often the law punishes equally severely for deliberate distortions and for accidental (technical) errors.

3. Credit risk is the likelihood that partners (parties to the contract) will be unable to fulfill their contractual obligations, both in general and for individual items. There are two types of credit risk: trade credit risk and bank credit risk. Trade credit risk arises in the financial activities of an entrepreneurial firm in the event that it provides a commodity (commercial) or consumer credit to customers. For a supplier of goods (services), this risk lies in the client's ability to pay for them in accordance with contractual obligations; for the client - in the supplier's ability to deliver (provide) them. The level of credit risk increases with the increase in the amount of the loan and the term for which it is taken. Exposure to credit risk persists for the entire lending period and is measured by the length of the lending period. The potential losses for any credit risk represent the entire amount of the debt, and the actual losses may be less than this amount.

Credit risk can be caused by the following reasons:

- a recession in the industry, a decline in demand for products manufactured by the company;
- non-fulfillment of contractual relations by the partners of the company;
- transformation of the firm's assets;
- force majeure circumstances.

4. Deposit risk - the likelihood of losses as a result of non-return of the company's deposits in banks. This risk arises relatively rarely and is associated, as a rule, with an incorrect assessment and an unsuccessful choice of a bank to carry out the company's deposit operations. It should be noted that the deposit risk is universal in nature. It is inherent in both developing and developed market economies.
5. Currency risk is the risk of incurring losses as a result of adverse short-term or long-term fluctuations in exchange rates in the international financial markets.
6. Investment risk is the likelihood of financial losses in the course of a firm's investment activities. In accordance with the possible types of this activity, there are two main types of investment risk: the risk of financial investment (risks in the securities market) and the risk of real investment (project risks).
7. Interest rate risk. This type of risk arises from unforeseen changes in the interest rate in the financial market (both deposit and credit). Interest rate risk leads to changes in the cost of paying interest or income on investments and, therefore, in a change in the rate of return on equity and capital invested in comparison with the expected rates of return. The reason for the emergence of interest rate risk is the change in the situation in the financial market under the influence of the external business environment, an increase or decrease in the supply of free money resources, government regulation of the economy and other factors. Banks and investment companies face interest rate risk primarily, but this financial risk corresponds to firms that use bank loans to finance their activities, and also invest temporarily free cash in assets that generate income in the form of interest (government securities, corporate bonds, certificates of deposit).
8. Business risk is one of the types of financial risks in H-art consulting typical primarily for joint stock companies; lies in the impossibility for the joint stock company to maintain the level of earnings per share at a constant level.

Business risk arises, as a rule, in cases when the production and economic activities of an entrepreneurial firm is under the influence of certain reasons less successful than what was planned.

## 1.2 Enterprise Risk Management Process

The development of the science of risk management is largely viewed from the standpoint of the risks of financial institutions in a relatively stable economic environment. The need to consider the risks of industrial enterprises in unstable political, economic and social conditions requires adjusting the existing principles of risk management and additional justification of the effectiveness of the methods of risk analysis [18].

One of the main reasons for ineffective risk management is the lack of clear and precise methodological foundations of this process. The analysis of the principles of risk management presented in the literature shows their fragmentation, and many controversial issues are inherent in individual attempts to systematize them. Nevertheless, the analysis of research in the field of risk management methodology, taking into account the requirements of the modern economy, makes it possible to form a system of risk management principles:

- the decision associated with the risk must be economically competent and must not have a negative impact on the results of the financial and economic activities of the enterprise;
- risk management should be carried out within the framework of the corporate strategy of the organization;
- risk management decisions should be based on the required amount of reliable information;
- when managing risks, decisions made should take into account the objective characteristics of the environment in which the company operates;
- risk management should be systemic;

- risk management should involve the current analysis of the effectiveness of the decisions made and the prompt updating of the set of principles and methods of risk management used.

The essence of each stage of risk management involves the use of different methods. The entire risk management process (stages) can be displayed in the form of a diagram.

The stage of setting goals for risk management is characterized by the use of methods for analyzing and forecasting the economic situation, identifying the capabilities and needs of the enterprise within the framework of the strategy and current plans for its development.

At the stage of risk analysis, methods of qualitative and quantitative analysis are used: methods for collecting existing and new information, modeling enterprise activities, statistical and probabilistic methods, etc.

At the third stage, a comparison of the effectiveness of various methods of influencing risk is made: risk avoidance, risk reduction, risk taking on oneself, transfer of part or all of the risk to third parties, which ends with the development of a decision on the choice of their optimal set.

At the final stage of risk management of the selected methods of influencing the risk. The result of this stage should be new knowledge about the risk, allowing, if necessary, to adjust the previously set goals of risk management.

Thus, at each of the stages, their own risk management methods are used. The results of each stage become the initial data for subsequent stages, forming a decision-making system with feedback. Such a system ensures the most effective achievement of goals, since the knowledge obtained at each of the stages allows adjusting not only the methods of influencing the risk, but also the goals of risk management themselves.

The basic stage that allows you to form a further risk management strategy is the stage of risk analysis. The task of a qualitative risk analysis is to identify the sources and causes of risk, stages and works, during the performance of which there is a risk, that is:

- identification of potential risk areas;
- identification of risks associated with the activities of the enterprise;
- forecasting the practical benefits and possible negative consequences of the revealed risks.

Qualitative analysis methods can be divided into four groups:

1. Methods based on the analysis of available information.
2. Methods for collecting new information.
3. Methods for modeling the activities of the organization.
4. Heuristic methods of qualitative analysis.

The final results of the qualitative risk analysis, in turn, serve as input for the quantitative analysis.

At the stage of quantitative risk analysis, numerical values of the probability of occurrence of risk events and the amount of damage or benefit caused by them are calculated.

Considering the entire set of methods for quantitative risk analysis, we can say that the application of a particular method depends on many factors:

- Each type of analyzed risk has its own methods of analysis and specific features of their implementation. For example, in the analysis of technical and production risks associated with equipment failure, the most common methods of building trees;

- for risk analysis, the volume and quality of the initial data plays a significant role. So, if there is a significant database on the dynamics of ROF, it is possible to use methods of simulation and neural networks. Otherwise, most likely the use of expert methods or methods of fuzzy logic;
- when analyzing risks, it is fundamentally important to take into account the dynamics of indicators affecting the level of risk. In the case of risk analysis in markets in shock, a number of methods are simply not applicable;
- when choosing analysis methods, one should take into account not only the depth of the calculated data, but also the forecast horizon of indicators that affect the level of risk;
- the urgency and technical capabilities of the analysis are of great importance. If the analyst has a solid computational potential and a margin of time, it is possible to train neural networks, simulate Monte Carlo, etc .;
- the effectiveness of the application of risk analysis methods increases with the formalization of risk for the purpose of mathematical modeling of its impact on the results of an enterprise. Currently, not only economic systems, but also industrial complexes have reached such complexity that often the calculation of their stability is impossible without elements of the theory of probability;
- it is necessary to take into account the requirements of state regulatory bodies for the formation of risk reporting. In the event that the use of simulation methods is required at the regulatory level, their use is mandatory.

All of the above allows us to conclude that for an effective analysis of the entire variety of risks in the activities of an enterprise, it is necessary to apply a whole range of methods, which, in turn, confirms the relevance of developing a comprehensive risk management mechanism. In modern economic conditions, characterized by political, economic and social instability, the existing management system at the enterprise should include a risk management

mechanism [19]. The first stage in the formation of a risk management mechanism at an enterprise is the creation of a risk management service. At the current stage of development of the Russian economy, the purpose of this service is to minimize losses by monitoring the activities of the enterprise, analyzing the entire range of risk factors, development of recommendations to reduce risks and control over their implementation. At the same time, it is important to determine the place of service in the organizational structure of the enterprise, determine the rights and obligations of its personnel and inform the employees of the enterprise about the functions of the service and the nature of its activities.

Sources of information intended for risk analysis are:

- accounting statements of the enterprise. These documents (balance sheet, statement of profit and loss, cash flow, etc.) in a concise form contain all the official information about the company - the state of fixed assets, the level of stocks of materials and finished products, the amount of receivables and payables, financial results activities of the enterprise, etc. Analysis of the financial statements of the enterprise will reveal a significant proportion of business, credit, organizational risks;
- organizational structure and staffing of the enterprise. Analysis of this information makes it possible to identify organizational risks;
- process flow maps (technical and production risks);
- agreements and contracts (business and legal risks);
- the cost of production. Its analysis allows you to identify the overwhelming majority of risk factors and determine the monetary value of losses due to the occurrence of risky situations;
- financial and production plans of the enterprise. The completeness of their implementation makes it possible to comprehensively assess the stability of the enterprise to the entire set of risks.

Socio-economic instability, in the conditions of which enterprises operate, makes its own adjustments both in the activities of business entities; and in the enterprise risk management mechanism. At the same time, it is practically impossible to trace its impact in full, but it is quite possible to determine the aspects of its impact on individual risks. Upon completion of the collection of information intended for risk analysis, the risk management service will be able to realistically assess the dynamics of the company's performance indicators, taking into account the impact of external and internal socio-economic and political factors, which will make it possible to comprehensively and professionally predict the future state of the market situation and realistically assess possible risks ...

The logical continuation of the work of the risk management service should be the formation of a program of measures for risk management, in the development of which the following should be taken into account:

- the amount of possible damage and its likelihood;
- existing risk reduction mechanisms proposed by the state and their production and economic efficiency;
- production and economic efficiency of the measures proposed by the service to reduce risks;
- the practical possibility of implementing activities within the allocated limit of funds;
- compliance of the program activities with existing regulations, the goals of long-term and short-term planning for the development of the enterprise and the main directions of its financial policy;
- subjective attitude to the risk of program developers and enterprise management.

When developing a program of measures for risk management, specialists of the risk management service should focus on the maximum unification of the formed assessments of the risk level, which is expressed in the formation of universal

parameters characterizing the amount of possible damage. As such parameters, it is most advisable to use the impact of risks on financial flows and the financial condition of the enterprise. ... The final stage in the development of the program is the formation of a set of measures to reduce risks, indicating the planned effect of their implementation, timing of implementation, funding sources and persons responsible for the implementation of this program. The program must be approved by the management of the enterprise and taken into account in financial and production planning. Below is an algorithm for the functioning of the organization's risk management mechanism.

In the process of implementing the program, the specialists of the risk management service must analyze the effectiveness of the decisions made and, as necessary, ensure that the goals and means of minimizing risks are adjusted. At the same time, it is recommended to accumulate all information about errors and shortcomings in the development of the program that appeared during its implementation. This approach will allow the development of subsequent risk mitigation programs at a higher quality level using the new knowledge about risk.

All of the above allows us to conclude that the mechanism of enterprise risk management in modern economic conditions

should have a clear hierarchical structure with the need to adjust it based on the results of the implementation of the risk mitigation program and taking into account changing impact factors.

An analysis of the works of domestic and foreign researchers in the theory and practice of risk minimization, the current state and trends in the development of the domestic economy, problems and features of the activities of enterprises in the real sector confirms the relevance and timeliness of the development of a risk management mechanism for an enterprise in modern economic conditions and

emphasizes the need for its implementation in the practice of financial and economic divisions of business entities.

### 1.3. Classification of financial risks in H-art consulting by characteristics

There are a lot of factors and sources of risks. They are presented in the table below and consider everything in more detail:

Signs of risk classification	
If possible insurance	insured
	not insured
By the level of financial losses	permissible
	catastrophic
	critical
By sphere of origin	external risk
	internal risk
Whenever possible foresight	predictable risk
	unpredictable risk
By the duration of exposure	constant risk
	temporary risk
Possible consequences	risk causes lost profits
	risk causes financial losses
	risk entails losses or additional. income
By object of origin	financial transaction risk
	financial activity risk

	the risk of the financial activities of the firm as a whole
Where possible further classification	simple risk
	complex risk

Fig 1. Signs of risk classification

So, whenever possible, insurance transactions are insured and not insured. The insured risks are a probabilistic event (previously agreed upon, for example bankruptcy, stoppage of production, etc.), which can be insured and thereby protect yourself from large financial losses. Due to non-insured risks, the enterprise often receives the main profit, since they are associated with solutions of increased risk, but bringing good profit, but if the result is unsuccessful, the financial losses will be such that they can lead to the ruin of the enterprise.

By the level of financial losses financial risks, in turn, are divided into acceptable, critical and catastrophic.

Risks for which financial losses do not exceed the full amount of profit according to the financial procedure performed are called admissible, that is, projects that entail acceptable risks do not lose their economic value and quite take place.

Critical risks are more dangerous and are associated with higher financial losses, in this case, the organization can not only remain with zero revenue, but also incur losses in the amount of total cash costs for the financial procedure and will be forced to replenish them from other channels of cash flow.

Catastrophic risks are associated with partial or complete loss of not only the invested funds for the economic operation (transaction), but also the property of the financial organization. Often, catastrophic risks are associated with the bankruptcy of an enterprise.

By sphere of origin risks can be external and internal. External risks - this is the objective side of risks, which is influenced by financial uncertainty from the outside, these risks are the same for any organization, regardless of its financial transactions. External factors can be taken into account, make assumptions, but you can never be sure of their stability. Internal risks are caused by internal policies, the choice of the correct financial management, the instability of financial capabilities, and frequent decision-making that entails large financial risks.

Speaking about choosing the right decision, financial risks in H-art consulting can be divided into predictable and unpredictable. Forecasted risks are risks that can be predicted by analyzing the level of economic development and competition in the market. This type of risk is relative. Unpredictable risks are the risks of force majeure situations, tax risks. By the duration of exposure highlight temporary and permanent risks. Constant risks are a consequence of the influence of constant factors characteristic of the activity of a particular enterprise and arising throughout the entire period of financial transactions. Currency and interest rate risks belong to the group of permanent risks.

In terms of possible consequences, risks are divided into three groups:

- risks causing lost profits, we are talking about a situation when the company as a result of a financial transaction receives less profit than planned.
- risks causing financial losses, that is, in this case, the enterprise goes into negative territory in any case and incurs losses.
- a risk that can entail, both additional income and financial losses. An example is speculative transactions or the execution of an investment project, when the initially expected profit can either increase in volume or decrease.

## **Chapter 2 Methods of mathematical modeling in determining the level of risk at H-ART consulting**

The main methods for determining the level of financial risk are economic and mathematical models, which are characterized by the presence of a random factor. Such models are called stochastic.

### **2.1 VAR method for assessing financial risks in H-ART consulting**

“The greatest benefit of VAR lies in the imposition of a structured methodology for thinking critically about risk. Institutions that go through the process of calculating the VAR are forced to face the fact of their exposure to financial risks in H-art consulting and establish appropriate risk management functions. Thus, the process of obtaining a VAR can be as important as the VAR number itself.”Philip Jorion.

Companies actively use in their work the VAR method (Value-at-Risk, VAR) to assess financial risk.

The VAR method has three main components.

First, it is necessary to choose the type of probability distribution, for this it is necessary to carry out a statistical analysis and choose a distribution method.

Secondly, it is necessary to determine the confidence level, that is, the level of the probability of financial losses, which we obtain as a result of the calculations, will not exceed the possible level of the probability of losses. Usually the possible level of probability is 95%.

Thirdly, it is necessary to know what time period we estimate for the level of risk probability. To assess these data, an analytical method is used, a

method based on the existing statistics of the level of risk, which was conducted earlier, and the Monte Carlo method.

2.2. The root mean square in measuring the level of risk in H-ART consulting

The standard deviation is the most common way to assess financial risk. The standard deviation is calculated by the formula:

$$\delta = \sum_{i=1}^n (R_i - \bar{R})^2 \cdot P_i,$$

Where  $R$  - expected profitability,  $P_i$  Is the probability of the i-th variant of the outcome of events.

This formula is for the ideal case when all parameters are known. If the probabilities are unknown, then another formula can be used:

$$\delta = \sqrt{\frac{\sum_{i=1}^n (R_i - \bar{R})^2}{n}}.$$

Where  $n$  - the number of periods.

The coefficient of variation is used to compare profitability and risk level.

$$V = \frac{\delta}{R},$$

Where  $R$  - the average value of the random variable.

The coefficient of variation can vary from 0 to 100%. The larger the coefficient, the stronger the variability:

- up to 10% weak;
- 10-25% moderate;
- over 25% high.

### Chapter 3. Mathematical formulation of the problem in H-ART consulting

The purpose of our research is to form a new method for finding the level of financial risk within the framework of the Bank's work. The object of the research is a client database, applying to which some mathematical methods, it is possible to draw a conclusion about the solvency or insolvency of clients. In the presented work, for the first time, a problem with such a formulation is investigated and, in addition, methods are used that have not been previously used by anyone. As a principle of optimality, Fisher's criterion is used to determine the most significant parameters and the classification method developed by K.V. Grigorieva. In the conditions of the financial crisis, the task of identifying the most solvent customers becomes especially relevant.

#### 3.1 Construction of a training sample using Fisher's criterion in H-ART consulting

Fisher's test allows you to compare the values of sample variances of two independent samples. Fisher's criterion is:

$$F_{\text{ФМН}} = \frac{\delta_x^2}{\delta_y^2},$$

Where  $\delta_x^2, \delta_y^2$  - variances of the first and second samples, respectively.

Moreover, it is necessary to take into account that a large variance would be in the numerator. Dispersions are calculated using the formula:

$$\delta_x^2 = \left( \frac{1}{n_1} \right) \cdot \sum (x_i - \bar{x})^2,$$

$$\delta_y^2 = \left( \frac{1}{n_2} \right) \cdot \sum (y_i - \bar{y})^2,$$

Where  $\bar{x}, \bar{y}$  - arithmetic means in the first and second samples, respectively.

We compare the obtained empirical value with the critical value in the Fisher table, taking into account the degrees of freedom and the level of significance. The degrees of freedom are found as  $k_1 = n_1 - 1, k_2 = n_2 - 1,$

Where  $n_{1,2}$  - the number of elements in the first second samples.

Using Fisher's criterion, we need to compare two samples of clients, to determine the degree of homogeneity of the parameters of the client database.

Let's examine each parameter.

### 1. Parameter "Income"

Доход		
№клиента	Первая выборка X	Вторая выборка Y
1	55000	35000
2	60000	55000
3	40000	120000
4	54000	65000
5	20000	52000
6	57000	25000
7	60000	45000
8	35000	35000
9	38000	60000
10	28500	45000
11	42000	23000
12	44000	23000
13	45000	40000
14	45000	35500
15	50000	28500
16	34000	38000
17	38500	
18	66000	
19	50000	
20	60000	
21	28000	
22	20000	
23	43000	
24	40000	
Суммы	1053000	725000
Среднее	43875	36250

Fig 3.1 Finding the sum and average of two samples of the "Income" parameter

Find the variances of both samples:

$$\delta_x^2 = 152005208,$$

$$\delta_y^2 = 607250000.$$

Thus, we get  $F_{\text{э.мн}} = 4 \dots$

By analogy, we will investigate the rest of the parameters.

## 2. Parameter "Marriage"

Брак		
№клиента	Первая выборка X	Вторая выборка Y
1	0	1
2	1	1
3	0	1
4	0	1
5	0	0
6	1	0
7	1	1
8	0	1
9	0	1
10	0	0
11	1	1
12	1	1
13	0	0
14	1	0
15	0	0
16	0	1
17	1	
18	1	
19	1	
20	0	
21	0	
22	0	
23	1	
24	1	
Суммы	11	10
Среднее	0	0,5

Fig 3.2. Finding the sum and average of two samples of the parameter "Marriage".

Find the variances of both samples:

$$\delta_x^2 = 0.248,$$

$$\delta_y^2 = 0.234,$$

Thus, we get  $F_{\text{э.мн}} = 1 \dots$

## 3. Parameter "Loan amount"

Сумма кредита		
№клиента	Первая выборка X	Вторая выборка Y
1	150000	190000
2	550000	240000
3	400000	1500000
4	230000	380000
5	340000	190000
6	250000	270000
7	900000	840000
8	250000	110000
9	180000	580000
10	150000	620000
11	220000	290000
12	850000	410000
13	1300000	360000
14	740000	980000
15	300000	800000
16	170000	320000
17	420000	
18	600000	
19	480000	
20	330000	
21	220000	
22	510000	
23	850000	
24	260000	
Суммы	10650000	8080000
Среднее	443750	404000

Fig 3.3 Finding the amount and average value of two samples of the "Loan Amount" parameter.

Find the variances of both samples:

$$\delta_x^2 = 84131770833,$$

$$\delta_y^2 = 137247500000.$$

Thus we get  $F_{эмн} = 1,6 \dots$

4. The parameter "Work experience"

Стаж работы		
№клиента	Первая выборка X	Вторая выборка Y
1	5	6
2	4	10
3	7	11
4	2	5
5	1	9
6	8	2
7	3	6
8	1	4
9	2	6
10	1	3
11	4	2
12	5	1
13	7	1
14	6	1
15	3	2
16	1	5
17	3	
18	6	
19	2	
20	1	
21	4	
22	3	
23	5	
24	4	
Суммы	87	74
Среднее	4	3,7

Fig. 3.4. Finding the sum and average value of two samples of the "Work experience" parameter

Find the variances of both samples:

$$\delta_x^2 = 5,$$

$$\delta_y^2 = 10,715.$$

Thus we get  $F_{\text{эмн}} = 2,4\dots$

5. Parameter "Desired time"

Желаемый срок		
№клиента	Первая выборка X	Вторая выборка Y
1	12	12
2	8	12
3	24	12
4	18	6
5	24	8
6	12	18
7	36	36
8	18	12
9	7	24
10	12	24
11	15	12
12	36	12
13	72	24
14	24	24
15	24	36
16	12	12
17	18	
18	36	
19	12	
20	36	
21	24	
22	36	
23	24	
24	12	
Суммы	552	284
Среднее	23	14,2

Fig 3.5. Finding the sum and average of two samples of the "Desired time" parameter

Find the variances of both samples:

$$\delta_x^2 = 192,$$

$$\delta_y^2 = 93.$$

Thus we get  $F_{эмн} = 2,1 \dots$

6. Parameter "Amount of monthly payment"

Сумма ежемесячного платежа		
№клиента	Первая выборка X	Вторая выборка Y
1	12500	15833
2	68750	20000
3	16667	125000
4	12778	63333
5	14167	23750
6	20833	15000
7	25000	23333
8	13889	9167
9	25714	24167
10	12500	25833
11	14667	24167
12	23611	34167
13	18056	15000
14	30833	40833
15	12500	22222
16	14167	26667
17	23333	
18	16667	
19	40000	
20	9167	
21	9167	
22	14167	
23	35417	
24	21667	
Суммы	506214	508472,2222
Среднее	21092	25423,6

Fig 3.6. Finding the amount and average of two samples of the "Amount of monthly payment" parameter.

Find the variances of both samples:

$$\delta_x^2 = 159906256,$$

$$\delta_y^2 = 768236087.$$

Thus we get  $F_{\alpha, mn} = 4,8 \dots$

7. Loan rate parameter

Ставка по кредиту		
№клиента	Первая выборка X	Вторая выборка Y
1	15,4	16,3
2	14,9	15,4
3	16,3	14,9
4	15,4	14,9
5	16,3	15,4
6	15,4	16,3
7	14,9	15,4
8	16,3	16,3
9	16,3	14,9
10	16,3	15,4
11	15,4	16,3
12	15,4	16,3
13	15,4	16,3
14	15,4	16,3
15	15,4	16,3
16	16,3	16,3
17	16,3	
18	14,9	
19	15,4	
20	14,9	
21	16,3	
22	16,3	
23	15,4	
24	16,3	
Суммы	377	253
Среднее	16	13

Fig. 3.7. Finding the sum and average value of two samples of the "Loan rate" parameter

Find the variances of both samples:

$$\delta_x^2 = 0,29,$$

$$\delta_y^2 = 10,33.$$

Thus, we get  $F_{\text{эмн}} = 35,1 \dots$

8. The parameter "Amounts of overpayment per month"

Fig. 3.8. Finding the sum and average of two samples of the "Amount of overpayment per month" parameter

Find the variances of both samples:

$$\delta_x^2 = 3403187,$$

$$\delta_y^2 = 22221910.$$

Thus, we get  $F_{\text{эмн}} = 1,7 \dots$

Therefore, we have ranked the client base according to Fischer according to the importance of the parameters, namely, the lower the value of the parameter, the more significant it is.

### 3.2. Determination of the optimal position of the training set hyperplane in H-ART consulting

Further, we will use the classification method developed by K.V. Grigorieva, namely: we will introduce a hyperplane and a certain criterion for identifying sets, with the help of which a training set will be formed. The essence of this method is to find such a position of the hyperplane for the training set, rotating and shifting it in space so that the number of incorrectly identified points that will be determined as "incorrect" using the above criterion.

Solving this problem, K.V. Grigorieva developed a method for classifying points of two generally inseparable sets using a continuously differentiable functional:

$$F_{\varepsilon}(\bar{y}) = \sum_{i \in I} \left[ \max \left\{ 0, \frac{r(a_i, \bar{y})}{|r(a_i, \bar{y}) + \varepsilon|} \right\} \right]^2 + \sum_{j \in J} \left[ \max \left\{ 0, \frac{-r(b_j, \bar{y})}{|r(b_j, \bar{y}) + \varepsilon|} \right\} \right]^2.$$

Using this method, it is possible to assess the degree of risk by the most significant parameters.

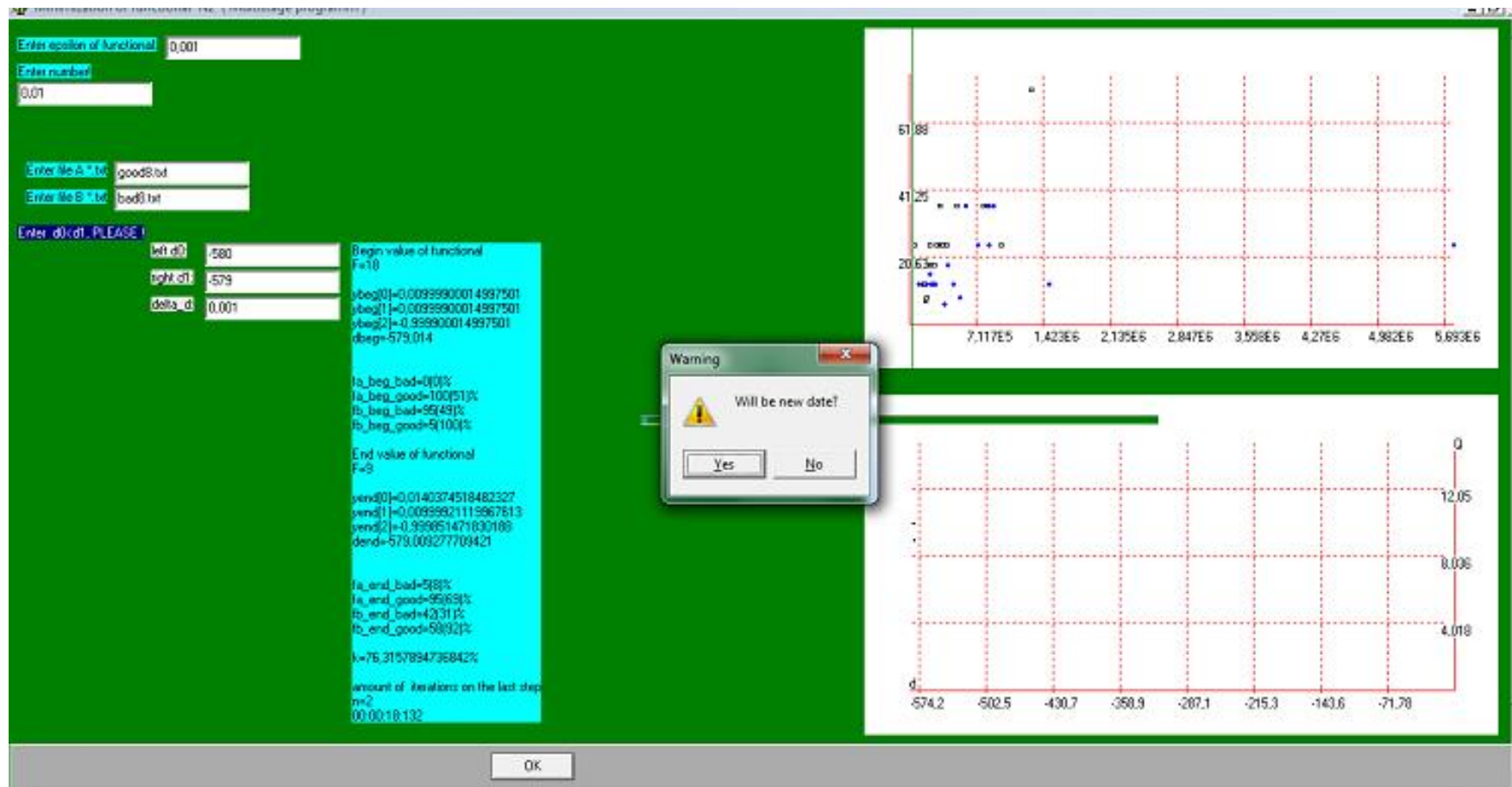


Fig. 3.9. Dividing the training sample by the most significant parameter, determined by Fisher's criterion, "Marriage".

### 3.3 Risk identification in H-ART consulting

We solve the problem of rotations of a hyperplane in space in such a way that the number of incorrectly identified points is as small as possible; this is a set of points and we declare the level of risk. In our case, the hyperplane divides the training sample into two sets with an accuracy of 76.39%, which means that the risk value is 23.61%.

### 3.3.1 Fundamentals of business information support methodology

Today, for the prosperity of any company, high-quality and timely management of its activities is necessary. In the conditions of the 21st century - the century of digital technology and information, the main condition for the correct decisions made by organizations is their comprehensive awareness. The fulfillment of this condition is currently possible only on the basis of modern information technologies. Therefore, now all firms: organizations of small and medium-sized businesses, large industrial complexes - are developing and implementing automated information systems to support their activities. The introduction of such systems increases the efficiency and reliability of the information received, the time for the current collection and processing of information is reduced, and this leads to the release of working time as managers and specialists to solve promising problems, and ordinary employees for a better and more productive performance of their functions. It becomes possible to periodically analyze information and identify problem situations.

The concept of "business information support" is very multifaceted.

The term "information support" means the following [33]:

- an organically interconnected set of elements, the interaction of which is organized in a certain way into a single technology that implements the rules and methodological principles for the effective transformation of information in accordance with the needs of management;
- "Information support" is information, knowledge provided to the consumer in the course of work to meet his information needs, and appropriately processed information;

- "Information support" is one of the components of modern automated systems, considered along with technical, software and other types of support;
- a complex dynamic complex process that ensures the satisfaction of the information needs of managers and performs the functions of rationalizing the activities of the management apparatus, that is, the process of providing information to individuals or groups (users of information systems) in accordance with their information needs.

Thus, business information support is the transformation of information using technical means to ensure the most effective management of all processes of the organization.

The components of the structure of the information support system are:

- automation of accounting and tax accounting;
- automation of IFRS and GAAP AS;
- business process automation;
- warehouse management automation;
- automation of payroll;
- automation of marketing management;
- budgeting and financial planning, etc.

Let's consider the components of the structure of this system in more detail.

Accounting and tax accounting are essential management tools for any organization, allowing to establish effective work in market conditions. In modern crisis conditions, the role and importance of integrated management of accounting processes is growing even more.

Thus, an integrated approach to the management of accounting and tax accounting processes is carried out through the automation of these processes. Automation of accounting and tax accounting is a ready-made solution for keeping records in organizations engaged in any type of commercial activity, and is the most effective tool for managing the activities of a company.

Accounting is traditionally called the language of business communication. It is obvious that the internationalization of business necessitates the internationalization of the language of its communication, both literally and figuratively. Thus, in the process of integrating business systems, it was revealed the need to define rules that are understandable to all participants, according to which the documents necessary for business communication will be drawn up. From 1973 to 2001, the International Accounting Standards Committee (IASC) developed financial reporting standards and issued them under the name International Accounting Standards (IAS). [34] Today it includes more than 100 countries. The standards currently being issued are called IFRS (International Financial Reporting Standards) - International Financial Reporting Standards. In this way, the IFRS system includes two types of standards - IAS and IFRS. Since 2005, all companies in the European Union are required to prepare consolidated financial statements in accordance with the principles of IFRS (International Financial Reporting Standards). In the United States, which now uses proprietary US GAAP accounting standards, in August 2008, the Securities and Exchange Commission presented a preliminary plan for the transition to IFRS and the phase-out of GAAP.

In accordance with this plan, already from 2010, multinational American companies (it is expected that by this time there will be at least 110) will be required to submit financial statements in accordance with IFRS.

It is assumed that from 2014, the formation of financial statements in accordance with IFRS will become mandatory for all American companies. [35] In Russia, in 1998, a program for reforming accounting in accordance with IFRS was adopted and is being implemented. In particular, since 2005, all credit institutions are required to prepare financial statements in accordance with IFRS. Today, more and more Russian companies prepare financial statements in accordance with international standards. First of all, these are companies focused on public financing markets or attracting investments from international financial organizations.

Thus, International Financial Reporting Standards (IFRS) is a set of generally accepted rules for qualification, recognition, assessment and disclosure of business transactions and financial indicators for the preparation of financial statements by business entities in most countries of the world. [36] IFRS is a system of documents consisting of prefaces to the provisions of IFRS, explanations of the principles of preparation and presentation of financial statements, standards and explanations (interpretations) thereto. Each of these documents has its own meaning, but, being an element of the system, it cannot be applied separately from the rest of its components. Today IFRS are recognized as global standards around the world.

Business is a process, a set of different actions (steps, stages, functions) that are carried out in a certain order and aimed at achieving the ultimate goal of the company, includes the activities of all participants in the process, and the interaction between them (company employees, management, customers). [37] Thus, the activities of any organization can be represented in the form of various interrelated business processes. Therefore, the management of the company's business processes is the primary task of the head, on which the success and

implementation of the entire business depends. There are three types of business processes [34]:

Managers are business processes that manage the functioning of the system. An example of a governing process is corporate governance and strategic management.

Operational - the business processes that make up the core business of the company and create the main stream of income. Examples of operational business processes are sourcing, manufacturing, marketing, and sales.

Supportive - business processes that serve the core business. For example, accounting, recruiting, technical support and others.

Today, every leader strives to organize the work of his company so that all business processes are carried out strictly according to the planned plan, without interruptions, with minimal time spent on mechanical paperwork. Currently, the most effective way to organize a business is to automate business processes on the basis of creating your own or implementing a ready-made information system, adapted for a specific customer company.

Today, there are manual, automatic and automated information management systems for the company. [37]

Manual information systems are characterized by the fact that all operations are performed by a person; such systems do not have modern technical means of information processing.

Automatic information systems perform all information processing operations without human intervention.

Automated information control systems are a synthesis of manual and automatic systems, assuming the participation of both humans and computers. Currently, this is the most modern type of information systems, with the help of which all routine data processing operations are assigned to a computer.

For the most part, the automation of business processes of an enterprise is a single database that stores all information and allows you to access any documents in electronic form from a single database. All this frees up time for employees who will be able to quickly and timely receive the necessary information without unnecessary effort. Business process automation systems make all business processes transparent. The manager can keep track of projects and the progress of employees.

Thus, the automation of business processes of an enterprise means clarity, structuredness and availability of information, a decrease in the share of the human factor and unnecessary paperwork. [38] Mechanisms for automating business processes can reduce the costs of any production and make the business more efficient.

Business process management automation is especially necessary for large enterprises. But first of all, everything largely depends on the management, and therefore on the head of the organization. Business process automation systems, management automation are tools, on the effective use of which the success of the economic activity of the entire organization as a whole largely depends.

Currently, more and more companies are in need of timely and reliable information to make high-quality management decisions. Enterprises pay attention not only to

the analysis of the results of their work, but also to planning further activities. This is expressed in the desire to effectively use their own resources and capabilities.

Today, one of the most demanded tools for operational planning and company management are budgeting and financial planning systems. Financial planning allows you to automate strategic and operational planning (budgeting), plan - factual analysis, modeling, analysis and forecasting of the financial condition of the organization as a whole.

Automation of budgeting has undeniable advantages for an organization, such as [39]:

- formation of budgets of various levels, ranging from the budgets of individual divisions to the consolidated budgets of the holding;
- formation of both basic budgets: cash flow budget, income and expenditure budget, forecast balance, and management budgets with a unique structure (project budgets, areas of activity, divisions);
- automation of the planning process (the system incorporates planning methods adopted in the company);
- simplification of collection of actual data for budgets, flexible adjustment of broadcasting rules;
- analysis of budgets and their execution by analytical aspects of budgeting.

Thus, the introduction of a budgeting system allows managers to: predict the development of the company in the short and long term, quickly and accurately obtain actual data, thus controlling the implementation of planned indicators, choose the right development strategy, control costs and carry out effective cash management.

It can be concluded that the development and implementation of automated information systems to support the organization's activities is necessary to increase the level of information reliability, efficiency in the organization's activities; for periodic analysis of information and identification of problem situations (risks) at the enterprise, that is, to improve the efficiency of management of the organization based on the use of an integrated approach to making management decisions.

### 3.3.2. Elements of business information support

Every year the number of information systems of various types and companies implementing or developing these systems is growing. Almost all the proposed software solutions are positioned as full-featured integrated management systems that provide automation of all major business processes of any enterprise (trade, manufacturing, service), and the companies offering these systems, respectively, as industry leaders. Development companies and companies implementing information systems are trying to position themselves in a certain way (and using positioning to show the initial advantages of their system over the competitive one).

In the totality of information management systems, two large classes can be distinguished: financial and management systems and production systems. Financial and management systems include subclasses of local and small integrated systems. Such systems are designed for accounting in one or several areas (accounting, sales, warehouses, personnel records, etc.). [40]

The systems of this group can be used by almost any company that needs cash flow management and automation of accounting functions. Systems of this class are universal by many criteria, although quite often developers offer solutions to

industry problems, for example, special methods of calculating taxes or personnel management taking into account the specifics of regions, etc.

The versatility leads to the fact that the implementation cycle of such systems is short, so sometimes you can buy a program and install it yourself on a personal computer.

Financial and management systems are much more flexible in adapting to the needs of a particular enterprise. Often there are "constructors" that can be used to almost completely "rewrite" the original system, independently or with the help of a vendor, to establish relationships between database tables or individual modules. Despite the fact that the general configuration of systems can be quite complex, almost all financial and management systems are capable of running on personal computers in conventional Novell Netware or Windows NT data networks. They rely on a technology that is characterized by a high load of network channels for transferring data between the server and workstations. Only some of the systems of this class offered in Russia were developed for industrial databases (Oracle, SYBASE, Progress, Informix, SQL Server).

Mostly simpler development tools Clipper, FoxPro, dBase, Paradox were used, which begin to malfunction on complex network configurations and with an increase in the amount of processed data. Manufacturing systems include subclasses of medium and large integrated systems. These systems are primarily intended for the management and planning of the production process. Accounting functions, although deeply developed, play a supporting role. Therefore, sometimes it is impossible to select an accounting module, since information is automatically supplied to the accounting department from other modules.

Production systems are much more complex to install (the implementation cycle can take from 6-9 months to one and a half years or more). This is due to the fact that the system covers the needs of the entire manufacturing enterprise, which requires significant joint efforts of the enterprise employees and the software vendor. [40]

Production systems are often focused on one or several industries and / or types of production: batch assembly (electronics, mechanical engineering), small batch and experimental (aviation, heavy engineering), discrete (metallurgy, chemistry, packaging), continuous (oil and gas production ). Presence of built-in models for certain types

production distinguishes production systems from each other. Each of these systems has deeply developed directions and functions, the development of which is just beginning or not at all. All production systems are developed using industrial databases. Thus, production systems in many respects are much more stringent than financial and management systems.

The main capabilities of production systems in the field of business automation, which were identified by the MESA Association (MES is a production management system) are [41]:

1. Condition monitoring and resource allocation.
2. Operational / detailed planning.
3. Dispatching production.
4. Document management.
5. Collection and storage of data.
6. Personnel Management.

7. Product quality management.
8. Production management.
9. Management of production assets (maintenance).
10. Track product history.
11. Performance analysis.

Thus, these capabilities and advantages of production systems in the field of business automation make it possible to link together all business processes of an enterprise with production processes.

In addition, they make it possible to promptly supply objective and detailed information to the management, conduct analysis and determine the most effective solution to the problem. For example, for a particular manager, such a decision may be a transition to other sources of raw materials, the introduction of automation systems at certain points in the technological process, a change in the delivery schedule, or a reduction in manual labor.

Financial and management systems are referred to as small integrated systems. To a greater extent, they are aimed at automating non-manufacturing enterprises (small and medium-sized enterprises in the field of trade and services). The main capabilities of financial and management systems in the field of business automation include the fact that they can be flexibly adjusted to the needs of a particular enterprise. Such systems integrate well the activities of the enterprise and are versatile.

Currently, there is a fairly large number of various domestic and foreign information systems on the domestic market, ranging from local, focused on solving narrow problems, and ending with large integrated systems that provide

automation of all business processes of an enterprise. The choice of the type of information system depends on the goals and objectives of the company's management.

Real estate activity is associated with the operation of a fairly large amount of information on the real estate objects being sold and their owners. In the process of a qualitative analysis of the existing risks of Expert-Real Estate LLC, it was revealed that legal risks, such as "information leakage", "economic espionage", pose a real threat.

These risks are primarily associated with insufficient security of the agency's client databases and real estate objects. Data protection from unauthorized access is one of the priority tasks in the design of any information system.

As a consequence of the increased importance of information in recent years, organizations have begun to impose high demands on data confidentiality. Database management systems have become the dominant tool in this area. Ensuring the information security of a DBMS (database management systems) becomes critical to ensure the required level of security for the organization as a whole.

Three main aspects of information security are important for a DBMS:

- confidentiality, integrity and availability;
- means of protection against unauthorized access to information;
- guaranteed protection of information for the period of time until unauthorized access to it entails any consequences.

The delimitation of access to data is also described in the database by means of restrictions, and information about this is stored in its system catalog. Sometimes additional information can be requested from the operating systems in which the database server and the client accessing the database server are running.

Depending on the center of responsibility of this real estate company, Expert-Real Estate, it is necessary to distribute risks and use certain resources for this (Table 16).

Table 16 - Allocation of risks and corresponding resources for their management depending on the center of responsibility

Responsibility Center	Risks	Resource usage
Director	<p>Legal risks (marriage in the work of a real estate agency and mistakes when concluding contracts) - the inclusion of additional clauses in the contract, checking the legal purity of the transaction.</p> <p>Financial risks - making managerial decisions in the field of managing the financial risks of an organization,</p>	Company employees, targeted funds.

	planning reserves, self-insurance, control.	
Outsourced risk management company (specialist)	Financial risks (monitoring of the enterprise and the environment of its functioning, analysis of possible risks, management in crisis situations.)	Targeted financial resources, information resources of the company.

Thus, we can conclude: in OOO "Expert-real estate" there are certain risks associated with the activities of the company. Their minimization is necessary for the normal functioning of the organization.

To increase efficiency in the field of legal risk management ("information leakage", "economic espionage"), Expert-Real Estate LLC proposes to introduce an information system for managing access to information, a real estate agency's database.

Losses related to unauthorized access:

- unauthorized copying, destruction or falsification of information;
- familiarization with confidential information.

Software security tools, including: user identification and authentication tools, access control tools, logging and auditing. Ensuring the required protection of information resources of enterprises is achieved by using additional tools. Security analysis tools for operating systems allow you to revise access control

mechanisms, identification and authentication, monitoring, and audit. In addition, the tools of this class monitor the integrity and invariability of software tools and system settings and check for vulnerabilities in system and application services for computers that implement the functions of protecting information from unauthorized access, review, copying, modification, destruction and blocking.

Software and hardware tools for protecting information from unauthorized copying include:

- means of protecting data carriers;
- means of preventing copying of software installed on a PC.

Software and hardware means of interrupting the operation of the user's program in case of violation of the access rules include:

- forced termination of the program;
- computer lock.

Software and hardware tools for issuing an alarm when attempting unauthorized access to information include:

- means for registering incorrect user requests to the protected information;
- means of organizing control over the actions of PC users.

To solve the above tasks, Expert-Real Estate LLC proposed to implement information security information systems such as: Microsoft Windows Server Standard 2008 with

built-in service Windows Rights Management Services (RMS) and system of protection of information from unauthorized access "Guardian NT" (version 3.0).

In order to determine the benefits of using systems by various categories of users from the implementation of an information system, it is necessary to determine the desired behavior of employees through a system of goals. In this case, incentive mechanisms are tied to the degree of achievement of the goal, which should be characterized by some indicator (Table 17)

Table 17 - Objectives of the employees of LLC "Expert-real estate"

Category	Objectives
Director	Reducing the likelihood and severity of consequences from possible risks ("information leakage", "economic espionage"), control over the actions of employees.
Employee	Conscientious attitude to the work performed, commitment to the organization

Thus, these systems, proposed for implementation in Expert-Real Estate LLC, prevent copying of programs installed on a PC (Realtor program), as well as control access to the agency's database.

### 3.3.3. Selection and implementation of an information system in an organization

Information is one of the most valuable resources of any company, therefore ensuring the protection of information is one of the most important and priority tasks.

The security of an information system is a property that consists in the ability of a system to ensure its normal functioning, that is, to ensure the integrity and secrecy of information. To ensure the integrity and confidentiality of information, it is necessary to protect information from accidental destruction or unauthorized access to it. Integrity means the impossibility of unauthorized or accidental destruction, as well as modification of information. Under the confidentiality of information - the impossibility of leakage and unauthorized seizure of stored, transmitted or received information.

The following sources of threats to the security of information systems are known:

- anthropogenic sources caused by accidental or deliberate acts of subjects;
- man-made sources leading to failures and failures of hardware and software due to outdated software and hardware or software errors;
- spontaneous sources caused by natural disasters or force majeure.

In turn, anthropogenic sources of threats are divided:

- on internal (influences from company employees) and external (unauthorized interference of unauthorized persons from external general purpose networks) sources;
- on unintentional (accidental) and intentional actions of subjects.

There are many possible directions of information leakage and ways of unauthorized access to it in systems and networks:

- interception of information;
- modification of information (the original message or document is changed or replaced by another and sent to the addressee);
- substitution of authorship of information (someone can send a letter or document on your behalf);
- exploiting the shortcomings of operating systems and application software;
- copying data carriers and files with overcoming security measures;
- illegal connection to equipment and communication lines;
- disguise as a registered user and assign his powers;
- introduction of new users;
- the introduction of computer viruses and so on.

To ensure the security of information systems, information protection systems are used, which are a complex of organizational and technological measures, software and hardware tools and legal norms aimed at countering sources of threats to information security.

An integrated approach integrates threat mitigation techniques to create a systems security architecture. It is necessary

note that any information protection system is not completely secure. You always have to choose between the level of protection and the efficiency of information systems.

The means of protecting IP information from the actions of subjects include:

- means of protecting information from unauthorized access;
- information protection in computer networks;
- cryptographic information protection;
- electronic digital signature;
- protection of information from computer viruses.

Means of protecting information from unauthorized access. Gaining access to the resources of the information system involves the implementation of three procedures: identification, authentication and authorization.

Identification is the assignment of unique names and codes (identifiers) to a user (object or subject of resources).

Authentication - establishing the identity of the user who submitted the identifier or verifying that the person or device that provided the identifier is indeed who it claims to be. The most common way to authenticate is to assign a password to the user and store it on the computer.

Authorization - checking the authority or checking the user's right to access specific resources and perform certain operations on them. Authorization is carried out in order to differentiate access rights to network and computer resources.

Information protection in computer networks. Local networks of enterprises are very often connected to the Internet. To protect local networks of companies, as a rule, firewalls are used - firewalls.

A screen (firewall) is an access control tool that allows you to divide the network into two parts (the border runs between the local network and the Internet) and

form a set of rules that determine the conditions for the passage of packets from one part to another. Screens can be implemented both in hardware and software.

Cryptographic information protection. To ensure the secrecy of information, its encryption or cryptography is used. For encryption, an algorithm or device is used that implements a specific algorithm. The encryption is controlled by a variable key code.

The encrypted information can only be retrieved using a key. Cryptography is a very effective technique that increases the security of data transmission over computer networks and when exchanging information between remote computers.

Electronic digital signature. To exclude the possibility of modifying the original message or replacing this message with another, it is necessary to send the message along with an electronic signature. An electronic digital signature is a sequence of characters obtained as a result of the cryptographic transformation of the original message using a private key and allows you to determine the integrity of the message and its identity with the author using the public key. In other words, a message encrypted with a private key is called an electronic digital signature. The sender transmits the unencrypted message in its original form along with a digital signature. The recipient uses the public key to decrypt the message's character set from the digital signature and compares it to the unencrypted message's character set. If the characters match completely, it can be argued that the received message is not modified and belongs to its author.

Information protection from computer viruses. A computer virus is a small malicious program that can independently create copies of itself and inject them

into programs (executable files), documents, boot sectors of storage media and spread through communication channels.

Unauthorized access to information and its copying, modification must be eliminated at Expert Real Estate LLC in order to avoid the risk of information leakage.

Unauthorized access to information is access to information stored on various types of media (paper, magnetic, optical, etc.) in computer databases, file storages, archives, secret parts, etc. of various organizations by changing (increasing , falsification) of their access rights.

In other words, this is access to information in violation of the official powers of an employee, access to information that is closed for public access by persons who do not have permission to access this information. Also, sometimes unauthorized access is called obtaining access to information by a person who has the right to access this information, in an amount exceeding that necessary for the performance of official duties. These are active steps to create the ability to dispose of information without the consent of the owner.

The creation and operation of information security systems is a complex and responsible process. The protection system must be adequate, reliable, effective and manageable. The effectiveness of information protection is achieved not by the amount of money spent on its organization, but by its ability to adequately respond to all attempts of unauthorized access to information.

The main threat to the information security of computer systems comes directly from employees. With this in mind, it is necessary to limit as much as possible the range of information to which employees are allowed and the range of actions that

they can perform when working with this information. Moreover, each employee should have a minimum of authority to access confidential information.

To achieve the goal of creating a legal risk management system for this enterprise based on the above, it is necessary to analyze various types of software for implementation Microsoft Windows Server Standard 2008 operating system with built-in Windows Rights Management Services (RMS) and information protection system against unauthorized access. "(Version 3.0). It is necessary to consider the functionality of these programs in order to choose the most optimal one for implementation in a given enterprise (Table 18).

Table 18 - Criteria for evaluating an information system and choosing an information system

P / p No.	Comparison criteria for information systems	Comparable information security information systems	
		Microsoft Windows Server Standard 2008 (Integrated Windows Rights Management Services, RMS)	Guardian NT (version 3.0)
one	Security system management	Simple	Simple

	(installation, configuration)		
2	Reliability	High	High
3	Information security class	Highest degree of protection	Highest degree of protection
four	Information leakage risk	Low	Low
five	Access to the information	<ul style="list-style-type: none"> <li>- management of access rights to confidential information;</li> <li>- delimitation of users' access to information of various levels of confidentiality in accordance with their existing tolerances;</li> </ul>	<ul style="list-style-type: none"> <li>- delimitation of users' access to information of various levels of confidentiality in accordance with their existing tolerances;</li> </ul>
6	Audit	<ul style="list-style-type: none"> <li>- protection of information from unauthorized printing, sending and copying;</li> </ul>	<ul style="list-style-type: none"> <li>- creation of a closed software environment for the user, allowing him to perform only a certain range of</li> </ul>

		- control of the integrity of protected resources (protection against unauthorized changes).	actions with information;  - control of the integrity of protected resources (protection against unauthorized changes);  - registration of documents issued for printing.
7	Installation cost	4,700	6,900

Based on the data presented in the table, the following conclusions can be drawn. The most optimal information security information system for implementation in this enterprise will be the Microsoft Windows Server Standard 2008 operating system with built-in Windows Rights Management Services (RMS). It is an add-on service for Windows Server Standard 2008 that helps prevent unauthorized access to electronic information online and offline, copying programs installed on a PC (Realtor software), and also provides access control to the agency's database.

RMS extends the enterprise's security strategy by protecting information with strong usage policies that accompany that data wherever it goes. You can define the circle of people and the level of their access to information, as well as the

operations that can be performed with the information. An organization can create its own templates for access control policies, such as Read-Only Confidential. These templates can be directly applied to, for example, customer and property details and emails.

Windows Rights Management Services provides restrictions on the view and use of data:

- encryption: restricts the audience for viewing data - only authorized users can do this;
- strict and constant policies of delimiting access to information are used;

RMS also allows third-party information technology developers to integrate information security tools into their products to create universal platform solutions.

Windows Rights Management Services has the following benefits:

- protection of classified information from unauthorized use;
- ensuring continuous protection of information wherever this information goes;
- minimal amount of work on administration and ease of operation;
- centrally defined and managed information use policies are fully implemented for data in electronic form;
- the system audits all information with limited access;
- the proposed flexible technology is easy to administer and lends itself well to expanding functions.

The information system implementation process consists of several stages, presented in Table 19.

Table 19 - Stages of implementation of the information system

P / p No.	Stage	Costs, rub.	Responsible for implementation
one	Installation and configuration of hardware and platform software	4,700	Provider
2	Providing advice on IT strategy	-	
3	Installing the Microsoft SQL Server 2000 Service Pack	-	

Documenting the project for the implementation of this information system consists of the following stages (Table 20)

Table 20 - Stages of project documentation

P / p No.	Documentation stage	Possible outgoing documents
one	Implementation and maintenance	- Guide for the implementation and maintenance of Microsoft Windows Server Standard 2008

		- standard forms of documents.
2	Training (consultation) for company management (director)	- training course, the topic "Main features and principles of work in Microsoft Windows Server Standard 2008"

These documents ultimately serve to achieve one goal: to confirm the quality of the final result, understood in a comprehensive manner:

- adherence to deadlines and resource constraints;
- providing the required functionality;
- achieving performance targets (performance, response time, reliability, etc.).

Windows Rights Management Services (RMS) is one of numerous out-of-order updates to Windows Server 2003. The product, which was developed in the early months of this operating system release, is the first incarnation of most of the capabilities of organizational information rights management in enterprises.

Windows RMS protects vulnerable e-mail and other documents by using entitlement technologies to restrict the ability to read, print, send, edit, and otherwise manipulate documents.

Windows RMS provides enterprises with a means of regulating rights to use internal documents, similar to Digital Rights Management (DRM) technology. In particular, the protection of sensitive data in Windows RMS is built on a platform

that uses the Read only, Print, and Do not forward strategies. It is possible to create your own strategy defining special rules, for example, regarding the confidential information of companies (company confidential policy). In addition, Windows RMS provides the ability to limit the validity of documents to a specific date.

Windows RMS does not protect enterprise documents from some threats. Some applications may ignore the Windows' Snapshot feature, which allows you to capture the contents of a frame seemingly protected by Windows RMS. However, Windows RMS technology has extensive document intrusion prevention capabilities.

Using the full functionality of Windows RMS technology has a number of requirements. The technology works only on Windows 2003 and requires the installation of Microsoft SQL Server 2000 Service Pack 3 (SP3). However, it is also possible to use Microsoft SQL Server 2000 Desktop Engine (MSDE) SP3 or later under test conditions. The server-side version of Windows RMS must operate within an Active Directory (AD) -based domain and use Microsoft Message Queue Services (MSMQ), Microsoft Internet Information Services (IIS) 6.0, and ASP.NET. Supported systems include Windows 2003, Windows XP, Windows 2000 SP3, Windows Me, and Windows 98 Second Edition (Win98SE). All of the listed client products require a download of the Windows RMS client edition, which can be deployed using Group Policy technology or your own software deployment system.

The establishment of a special confidentiality regime is aimed at creating conditions for ensuring the physical protection of confidential information carriers.

The requirements of the special confidentiality regime established at the enterprise are drawn up in the form of organizational and administrative documents and are communicated to the employees of the enterprise for review.

Restricting access to confidential information contributes to the creation of the most effective conditions for the safety of confidential information. It is necessary to clearly define the circle of employees allowed

to confidential information, to what specific information they are allowed access and the authority of employees to access confidential information.

As practice shows, in order to develop the necessary set of measures for the protection of information, it is desirable to attract qualified experts in the field of information protection.

As noted above, the effectiveness of information protection in automated systems is achieved by using information security tools (ISS). Information security means means a hardware, software or material designed or used to protect information.

At present, the market offers a wide variety of information security tools, which can be conditionally divided into several groups: means that provide delimitation of access to information in automated systems; means ensuring the protection of information during its transmission via communication channels; means that provide protection against information leakage in various physical fields arising during the operation of technical means of automated systems; means that provide protection against the effects of virus programs; materials ensuring the safety of storage, transportation of information carriers and their protection from copying.

Information security systems (SSS) provide for the maintenance of a special log in which certain events related to user actions are recorded, for example, recording (modifying) a file, launching a program, printing, and others, as well as attempts to unauthorized access to protected resources and their results.

It is especially worth noting the availability of protection for loading the operating system from floppy disks and CD-ROMs, which protects the protection means themselves from hacking using special technologies. In various information security systems, there are software and hardware-software implementations of this protection, however, practice shows that software implementation does not provide the required resistance.

Despite the functional commonality of information security tools of this group, information security systems from various manufacturers differ: operating conditions (operating environment, hardware platform, stand-alone computers and computer networks); the complexity of setting and managing the parameters of the ISS; the types of identifiers used; a list of events to be registered; the cost of protective equipment.

With the development of network technologies, a new type of information security system has appeared - firewalls, which provide solutions to such tasks as protecting connections to external networks, differentiating access between segments of a corporate network, protecting corporate data streams transmitted over open networks.

Information protection during its transmission through communication channels is carried out by means of cryptographic protection (CIP). A characteristic feature of these tools is that they potentially provide the highest protection of transmitted

information from unauthorized access to it. In addition, cryptographic information protection tools provide protection of information from modification (use of digital signature and imitation insertion).

As a rule, cryptographic information protection tools function in automated systems as an independent tool, however, in some cases, cryptographic information protection tools can function as part of access control facilities as a functional subsystem to enhance the protective properties of the latter.

Providing a high degree of information protection, at the same time, the use of cryptographic data protection tools entails a number of inconveniences: the stability of the cryptographic data protection tool is potential, that is, it is guaranteed subject to a number of additional requirements, the implementation of which is rather difficult in practice.

In general, when determining the need to use cryptographic information protection tools, it is necessary to take into account the fact that the use of cryptographic information protection tools is justified in cases of explicit interception of truly confidential information.

A radical way to protect information from leakage through physical fields is electromagnetic shielding of technical devices and premises, but this method requires significant capital expenditures and is practically not used.

Materials ensuring the safety of storage, transportation of information carriers and their protection from copying. Basically, these are special thin-film materials with a changing color gamut or holographic marks that are applied to documents and objects (including elements of computer technology in automated systems). They

allow: to identify the authenticity of the object; control unauthorized access to them.

There are various tools for analyzing the security of computer networks. The widespread development of corporate networks, their integration with public information systems, in addition to obvious advantages, generates new threats to information security. The reasons for the emergence of new threats are characterized by: the complexity and heterogeneity of the software and hardware used in corporate networks; a large number of network nodes participating in the electronic exchange of information, their territorial distribution and the lack of the ability to control all settings; the availability of information of corporate systems to external users (customers, partners, etc.) due to its location on physically connected media.

The use of the information protection tools described above, as well as the information protection mechanisms built into operating systems, does not fully eliminate these threats. The presence of permanent or temporary physical connections is the most important factor that affects the increase in the vulnerability of corporate systems due to gaps in the used security and software tools and information leakage due to erroneous or illiterate actions of personnel.

Information support of the real estate business plays an important role for the effective work of the organization as a whole. Today, the information capacity of the real estate market is obvious. Information technology acts as a tool for the work of every realtor. The protection of information about real estate objects and agency clients gives the company obvious advantages.

One of the components of the continuous protection of information is protection throughout the entire period of its existence: from the moment of creation, during its storage and transmission, and up to the moment of destruction. The owner of the information determines which of the users can access it, how and for how long it can be used. The most effective solution for protecting data in an organization is a system of continuous information protection, which is built on the basis of Microsoft Windows Rights Management System Windows RMS is well integrated into the corporate information system.

Microsoft RMS allows you to protect information not only within the corporate network, but also data sent outside of it, which allows to reduce to a minimum the probability of the occurrence of legal risks of Expert-Real Estate LLC (“information leakage”, “economic espionage”).

Also, the introduction of this information system will ensure information security according to the following criteria:

- confidentiality - protection from unauthorized receipt of information;
- integrity - protection against unauthorized changes to information;
- availability - protection against unauthorized retention of information.

## Conclusion

In this work, the goal was to form a new method for finding the level of financial risk within the framework of the Bank's work. The object of the research was a client database, applying to which some mathematical methods; it would be possible to draw a conclusion about the solvency or insolvency of clients. As a principle of optimality, the Fisher criterion and the classification method developed by K.V. Grigorieva were used. In the conditions of the financial crisis, the task of identifying the most solvent customers is of particular relevance. It is assumed that the results obtained can be used in the banking sector.

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