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Recker Nicholas – PhD, Associate Professor, Metropolitan State University of Denver, tel.: 3035563167, E-mail: nrecker@msudenver.edu, Denver (USA)

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App Development for Android

E.G. Alekseev, H.K. Karim Hassan, P.S. Korotin,
O.A. Kulikov

N.P. Ogaryov Mordovia State University, Saransk (Russia)

Key words and phrases: Android application, web service, list view, research program.

Abstract. The aim of this paper was to study the development and implementation of an Android application that uses a web service. The theoretical part of the scientific article discussed the Android platform, its history, compatible web services and the methods used in this process. The hypothesis is that the study of this topic can be expanded with the further development of the application, improving the design and adding more functionality. The article used several methods: theoretical method and development method. The result of this scientific project was a working Android application that can connect to the Parse web service.

Introduction

This article is about developing an Android app [2]. In the modern world, gadgets play a very important role in the human life. Many people cannot imagine even one day without their mobile device. We use them for many things - finding information, communicating, etc. The development of an application usually takes a lot of time and requires professional knowledge of the software.

The uniqueness of our idea is the combination of the end user and the developer. There are also many separate forms where people can share their ideas. But there are no dedicated ones that could serve as one of the sources for projects. And of course there is no Android app where users can share their ideas. Based on this, we can conclude that our application is necessary for a modern development environment and will be well-demanded by Android users.

Materials and methods

Android is one of the open source platforms. It is created by Google and belongs to the Open Handset Alliance [1]. It is designed to “accelerate mobile phone innovation”. Thus, Android has taken the field of mobile innovation. It is definitely a free and open platform that differs in hardware from the software that runs on it. This results in many more devices running the same application [3].

In recent years, due to the rapid development of mobile platforms, the need to store and exchange information between different devices has increased. The entire process from installation to launch of most applications is supported using various web sources and services.

Since such a product was necessary, many companies created mobile services. Companies like Amazon, Google, and Parse offer their web services for a fee or, in some cases, for free [4]. Cloud applications are based on the idea that large data sources can provide data to any application that requests it. Cloud clients can be smartphones, tablets, and mobile Internet devices. When developing cloud applications, we no longer need to use the device's storage capabilities. The only thing that matters is network bandwidth and display capability [5].

Development

The Android project structure is basically the same, but it can also differ depending on the needs of the project and the IDE tool. We will describe the basic structure when using ADT. When the programmer uses ADT, the project structure is generated automatically. Moreover, ADT also generates a ready-made "Hello word" application. The GUI version of ADT is the easiest way to create an Android project, but an advanced programmer can also use a set of tools that can be run in a terminal session. A terminal tool called "ant" can debug an Android project and create an example structure, even if the developer uses any other programming tool other than Eclipse [6].

The first thing that will be developed is a view that will consist of a greeting for the user and two large buttons. The buttons will allow the user to switch to a new view depending on their choice. The first option will show all published ideas and their status. This option will be processed by the idea list view. The second option will introduce the idea. This function will handle the view – "add an idea". The idea presentation will consist of images and text information. Text views will display information about the idea, such as the name, brief description, and status of the app. The "Add ideas" will prompt the user to enter a name and description for the application. The main view of the prototype application will mean a simple view. Linear Layout is used in organizations. This operator is the parent layout operator for an XML document of the main view.

List View

The list view is more complex than the main view. In our case, the list view is created using two separate XML documents. The main document will have a list view and will define its position in the document. The adapter view will determine the position of the item within one list item. You can use the standard list of adapters provided by the Android platform, but in this case a custom adapter is more appropriate. Later, each item will be added to the list using Java code. An example of a list operator is a regular XML tag that uses the ListView definition. The detail view consists of a linear layout and two text view elements. The layout is vertically oriented, so items are arranged according to the vertical scale.

Each Android app has its own initial activity. In the project, this will be the main activity class by default, but since we use the SDK from Parse.com our initial activity differs from the standard one. Parse developers create two classes: ParseApplication and ParseStarterProjectActivity. In the ParseApplication class, we initialize our application and register it in Parse.com. This is done using the initializing operator.

Since we created this layout earlier and it has two buttons, we need to configure the methods that are triggered by clicking these buttons. Methods do not return any values and simply move the user to the next state depending on their choice. Since these methods will not return any values, they can be set as a void method, and since we would like to use them inside the entire

application, we should make them public. Adding an idea will have two methods. The OnCreate method will be called when creating an action. Also in this method, we will establish a connection to the parsing server and execute the request.

To analyze the data in the newly created list, we use a loop. In the loop, we add a name and description field, as well as an image that will be the app's logo. After that, we need to use an adapter that will generate the layout and enter data into the generated layout elements. The detailed view of the idea will display detailed information about the selected item.

When we get an object, we can extract the object's properties. In this case, we only get the name and description of the idea. Then we assign it to the text views that were defined in the detail-view layout. After that the device will work and display the text representation of the information inside.

Conclusions

Our project led to the creation of a working prototype that can perform a simple operation with sending to the server and extracting data. The application can publish to the server and get information from the server. It can be installed and run on multiple devices simultaneously. The prototype runs on the Android platform and is based on the Java framework. It uses one of the web services to store and retrieve information. Information is stored online and can be accessed at any time. In the article, we noted several stages: creating a product, creating a theoretical background, creating an environment for application development, developing an application model, implementing a prototype, and performing testing. The research methods comprised literature review and rapid application development. We have defined four main layouts: the main layout, the add idea layout, the list idea layout, and the detailed view layout. Functionality was added to the project using four main Java classes.

In general, we can say that the topic is relevant and requires a comprehensive and in-depth study.

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Разработка приложений для Android

Е.Г. Алексеев, Х.К. Карим Хасан, П.С. Коротин, О.А. Куликов
ФГБОУ ВО «Мордовский государственный университет имени Н.П. Огарева», г. Саранск (Россия)

Ключевые слова и фразы: Android-приложение; веб-сервис; программа исследова-

ний; просмотр списка.

Аннотация. Целью данной работы было исследование процесса разработки и реализации приложения Android, которое использует веб-сервис. В теоретической части научной статьи обсуждалась платформа Android, ее история, совместимые веб-сервисы и методы, использованные в этом процессе. Гипотеза заключается в том, что изучение данной темы может быть расширено с дальнейшей разработкой приложения, улучшением дизайна и расширением функциональности. В статье использовались теоретические методы и метод разработки. Результатом этого научного проекта стало работающее приложение для Android, которое может подключаться к веб-сервису Parse.

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UDK 004.8

Neural Network Model for Finding Contradictions in Natural Language Use Using TripletLoss Function

A.S. Tregubov, O.V. Malyugina

Novosibirsk State University,
Novosibirsk (Russia)

Key words and phrases: TripletLoss; neural network; nlp; dataset; loss function; machine learning; neural networks; contradiction analysis; deep learning.

Abstract. This paper is devoted to the analysis of natural language texts in order to search for contradictions. The relevance of choosing this topic is due to the fact that the constant increase in the volume of data located on the Internet makes it almost impossible to manually verify and analyze it. The aim of this work is to develop a model and algorithm for training a neural network, which allows to find contradictions in the texts of the natural language, in particular the texts of news articles. To achieve this goal, the tasks of training, training and test samples were solved, the Bert pre-trained neural network was chosen as the basic language model, the architecture and method of training the neural network using the TripletLoss loss function were proposed. The proposed model was implemented in Python and tested. The accuracy of the predictions of the proposed model was 53 %. The accuracy of the training set can be improved by increasing the training set, as well as modifying the architecture using simplified neural network architectures such as SoftTripletLoss due to their less demanding training set.

Introduction

Half a century ago writing a program for electronic devices was such a complicated task that only people with specialized education and an outstanding level of intelligence could undertake it. However, nowadays the demand for software development has drastically risen. Thus, an increased effort has been put into reducing the threshold level of entering the software development market. New programming languages emerge that create greater abstractions over the existing approaches, new code libraries are created that allow the developers to complete complex tasks with a code consisting of just a few lines. It all testifies to the fact that such specialists are in great demand.

The bulk of tasks the developers routinely have to complete consists in automatizing different processes. Knowledge of programming languages allows them to automatize any operations

that can be algorithmicized. A computer program is impartial, is devoid of such drawback as the "human factor", and cannot get tired. If the algorithm is written correctly, the probability of an error is minimal. Today businessmen are trying to automatize all kinds of processes since it can help to reduce the number of employees and optimize business running costs.

However, there is large body of tasks which cannot be algorithmized. Let's take a dog breed photo identifier or voice recognition software as just two examples. The problem with such tasks is that knowledge of linguistics or zoology is necessary to perform them. How ever even if a specialist has such knowledge, it's very difficult to come up with an algorithm capable of carrying them out. It can be explained by the fact that even the specialists in a given field cannot always formulate a precise set of rules and exceptions from them and often reach their conclusions based on their own experience.

Nowadays, neural networks and deep learning have become extremely popular. To a large extent it has been conditioned by their ability to tackle the tasks that can be solved based on experience. At the core of neural networks lies the algorithm of gradient descent, which in essence presents a task of optimization in N-dimensional space. In other words, a neural network learns to make a conclusion based on a large number of parameters. Their number can reach the figure of 1024 or 2048. Knowing the initial parameters and the expected solution, it is possible to make the calculations imbedded in the neural network closer to the reference sample.

One of the tasks that could not be solved before is the task of intellectual text analysis. For example, identifying emotional coloring of texts, extracting event sand facts from them or finding contradictions in them are some of the examples of tasks which neural networks can tackle.

Dealing with the last task mentioned above is particularly urgent in the present-day context. Quite recently such a phenomenon as information war has emerged. Often the news we receive constitutes the means of manipulating the public opinion but not the means of providing the consumers with the truth. Events in Donbass and South Ossetia as well as the annexation of Crimea are some of the brightest examples of such manipulation.

The purpose of this article is to design a model and a learning algorithm for the neural networks that can result in finding contradictions in the texts of natural language articles.

To achieve this goal, it is necessary to complete the following tasks:

1) to prepare a data set necessary for the learning process;
2) to choose the algorithm for teaching the neural network;
3) to conduct the experiment and receive the results.

The structure of the article is as follows: first the literature review is presented; after that the process of preparing the articles suitable for the learning process is explained; next the algorithm chosen for the process of teaching the neural network is explained; after that the description of the experiment and the obtained results is made; finally, the conclusions are made and possible future directions of the research are enumerated.

Literature review

Different approaches are used to solve the problem of finding contradictory information in texts. One of the most trustworthy and at the same time difficult to deal with is the approach known in the related studies. The availability of formalized knowledge opens great prospects for their future processing.

The task of generating new knowledge, logical deduction, testing the completeness of knowledge and searching for contradictions are easy to algorithmize; however, the problem with

this approach is that preliminary information processing is very complicated.

The first attempts to solve the problem of knowledge extraction were made half a century ago. However, because of a high complexity resulted from natural limitations such as its unstructured nature and a high level of dependence on the language algorithm, research in this field has not produced any significant results. But a surge in the development of neural networks made it possible to return to the attempts to solve this problem using new approaches. Since the task of extracting knowledge is more general, a decision was made to use more narrow-specialized approaches in this work. However, these approaches will be used in the future to develop them further.

In general, the task of finding contradictions is similar in its structure with the tasks of identifying the person from his/her photo or identifying a specific presenter from a recording of his voice. Completing such tasks has been recently made possible with the help of neural networks. It has become possible thanks to the emergence of a new approach to teaching the neural networks referred to as Distance metric learning in research publications in English.

In the work [2] a mathematical model of this approach is described. Its essence is that the neural network must be taught to produce such numerical representations for words and sentences that texts similar in meaning, description and signification are found close together. With this, the difference in distance between the vectors is usually calculated through L2-norm.

Triplet Loss has become one of the most common approaches to implementing the given approach to learning/studying. It was first used/applied in 2015 [3].

The primary task was to learn to recognize a person from his/her photo. This task is rather difficult to address using usual neural networks because in a primitive case a neural network has an output layer corresponding to the number of possible clusters. The number of people cannot be given as such a set because it is a variable number, while changing the number of neural network exits presupposes the necessity for its complete retraining.

The proposed method consisted in creating a learning batch that consists of 3 elements: an anchor, a positive and a negative example. The goal of learning consists in achieving such numerical representation of the photo that the anchor and the positive example are located closer together while the negative one is moving away from them.

In contemporary studies this method is used to verify the user identification by voice [4; 5]. In a number of works the results of testing the same architecture taught on the data sets with visual and audio data formats are given. One of simplified versions of Triplet Loss is its modification Soft Triple Loss [6]. The last modification is simple to teach and can be described as a certain modification of Softmax loss function.

In [7] the question of searching for contradictory data is discussed; in this research study the main data set is comprised of a data collected on Twitter. The main goal of this work is to find unsubstantiated rumors that circulate on the web. The author of this work proposes to use 2 criteria to find such messages: emergence of posts contradicting to the current one and at the same time making a reference to the initial post as well as a search for disagreements with independent massages published on the web. The authors propose to use the technique of determining logical sequencing for a pair of texts, with RTE-3 used as a learning set. It contains sets of pairs which present either a logical sequence, a contradiction or non contradictory statement. To analyze the propositions and classify the reactions of the subject on the actions of the main figure PHEME dataset was used.

The conducted literature review has shown the currency of the chosen research topic and helped to determine the means and models that will be used to solve the given task.

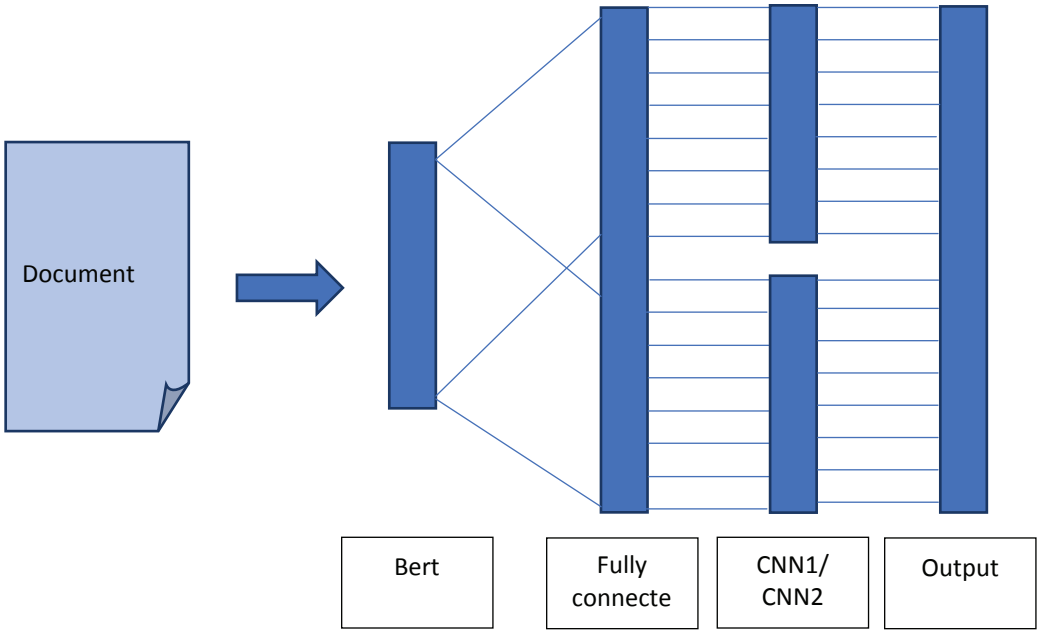

Fig. 1. A neural network model

Proposed solution

Within the framework of this work it is proposed to use Triplet Loss function to teach the neural network. The chosen approach has shown high results at the competition-based neural network design. However, it should be pointed out that it is rather difficult from the point of view of conducting the educational process. A rather important factor determining the success of the obtained neural network model is the choice of the dataset for teaching the given network. The news articles describing controversial events taking place around the world, such as the war in Donbass and the annexation of the Crimea have been chosen as the target category of texts that will be compared by the neural network. Such topics are often covered in a distorted way, so people generally refer to this phenomenon as an information war. However, the author failed to find a corresponding dataset that contains examples of such articles.

The process of data collection for this article took quite a considerable amount of time because a large variety of examples in different languages is necessary to educate the neural network correctly. The data was collected manually using different search engines in different languages, then the queries were formulated and the articles on the chosen topics were selected. After that each article was read and manually classified into different categories. To avoid subjectivity of judgments the decision was made to avoid such notions as positive or negative side (of the matter)in this work. The main purpose of Triplet Loss is not to classify an article as either good or bad but to answer the question whether the chosen articles represent a common point of view or differ in their judgement.

The model of the neural network can be approximately described as follows: to map the word a pre-trained model Bert is used, then several CNN layers are added that must learn to single out specific facts and events.

The chart shows a neural network model where in the beginning a classical realization of Bert designed by Google is used, then the Autoencoder is used to compress the information and eliminate the noise, which will allow the following layers to receive only the necessary

Table 1. Neural networkquality metrics

Precision	Recall	F-score
0.53	0.74	0.61

information to enter the system. CNN 1 is a set of layers of a super accurate neural network used to single out facts, while CNN2 is used to single out events. Thus, a neural network was received that can single out facts presented in this article.

TripletLoss learning algorithm allows selecting the parameters in such a way that articles describing facts and events that are close together will be located close to each other too. It will help the researchers to identify the articles that refer to the same events but describe the facts differently.

A standard approach will be used as the learning algorithm, within which triplets of examples from the dataset are selected, in which one of the them is called an anchor, another one is similar to an anchor, while one more is different from it.

The goal of learning is to receive such a kind of embedding when the anchor is located closer to the positive example than to the negative one.

To train and test the model presented in this work a dataset that consists from 100 news articles devoted to arguable historical events, such as the war in Donbass, the annexation of the Crimea by Russia, events in Abkhazia and Southern Ossetia. First, all the articles were classified manually. Since the given dataset is rather small, the decision was made to split it into several samples with the ratio 75/15/10 and make 30 such samples. Thus, the same neural network architecture was taught and validated 30 times. After that 5 most productive variants of the taught network were chosen as the weight for each node in the system, after which the average of the chosen variants was set for the neural network as a whole.

Results

To evaluate the quality of the neural network the following metrics presented in the table below was used.

Thus, the presented neural network architecture and the method of training it have shown worthy results as regards searching for contradictory texts. Since the issue of finding independent and unprejudiced news articles is very urgent, this research should be developed further. In particular, such steps as broadening the dataset, using other Embedding layers or changing the structure of the neural network itself can be considered.

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Модель нейронной сети для поиска противоречий в текстах естественного языка с использованием функции потерь TripletLoss

А.С. Трегубов, О.В. Малюгина

ФГАОУ ВО «Новосибирский национальный исследовательский государственный университет», г. Новосибирск (Россия)

Ключевые слова и фразы: TripletLoss; анализ; анализ противоречий; глубокое обучение; компьютерная лингвистика; машинное обучение; нейронные сети; обработка текстов естественного языка; функции потерь.

Аннотация. Данная работа посвящена вопросу анализа текстов естественного языка с целью поиска противоречий. Актуальность выбора данной темы обусловлена тем, что постоянный рост объемов данных, расположенных в сети интернет, делает практически невозможным их ручную проверку и анализ. Целью данной работы является разработка модели и алгоритма обучения нейронной сети, позволяющей находить противоречия в текстах естественного языка, в частности, текстов новостных статей. Для достижения данной цели были решены задачи подготовки обучающей и тестовой выборок, в качестве базовой языковой модели была выбрана предобученная нейронная сеть Bert; предложена архитектура и метод обучения нейронной сети с использованием TripletLoss. Предложенная модель была реализована на языке Python и протестирована. Точность предсказаний предложенной модели составила 53 %. Точность обучающей выборки можно повысить за счет увеличения объемов обучающей выборки, а также модификации архитектуры с использованием упрощенных архитектур нейронных сетей, таких как SoftTripletLoss.

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UDK 69

Formation of a Model to Assess Risk Factors Affecting Sustainable Functioning of Construction Enterprises

I.L. Abramov, Z.A. Al-Zaidi

National Research Moscow State University of Civil Engineering, Moscow (Russia)

Key words and phrases: construction enterprises; Dempster-Shafer theory; risk; risk factors; statistical method.

Abstract. Among the distinctive features of construction projects, it should be noted the complexity and specificity of the final products in the form of buildings and structures for various purposes. When implementing investment construction projects, a large number of risk-forming factors arise. These factors can have an impact on the sustainable operation of construction enterprises and cause such risks as violation of deadlines for commissioning, the occurrence of construction in progress, increase in cost and low quality of products. In this regard, the search for and generalization of methods for assessing risk-forming factors that affect, among other things, the sustainable functioning of construction enterprises in the implementation of investment projects becomes particularly relevant. This article discusses the process of developing a model based on the Dempster-Shafer evidence theory to assess the risk factors that arise during the implementation of an investment construction project and cause risks. The assessment method using the specified mathematical model is compared with the traditional and statistical (arithmetic mean) methods of assessing construction risks.

The research has shown that the Dempster-Shafer evidence theory is an effective tool for forming a model for a comprehensive and in-depth assessment of risk factors that hinder the successful implementation of an investment and construction project. It is established that there is a correlation between the evaluation method under study and other similar methods (traditional and statistical).

The main advantage of the proposed assessment method is that it facilitates the search for the most optimal management decisions in conditions of risks and uncertainty.

Construction is one of the most dangerous types of economic activity, which is associated

Table 1. Composition of resource potential

R = I × P		Probability				
		Impossible	Improbable	Possible	Probably	Most probably
Impact	Minor	1	2	3	4	5
	Medium	2	4	6	8	10
	High	3	6	9	12	15
	Critical	4	8	12	16	20
	Catastrophic	5	10	15	20	25

Table 2. Weight values for the degree of influence of each response category

Response category	Period	Period center
Ineffective	0 – < 1	0.5
Small effect	1 – < 2	1.5
Average effect	2 – < 3	2.5
Influential	3 – < 4	3.5
Very influential	4 – < 5	4.5

with a large number of risk factors. Therefore, every construction project is subject to unexpected situations and involves a high degree of uncertainty. Uncertainty increases as the number of factors affecting the project increases, and as the degree and duration of their impact increases.

Since construction production from the point of view of measuring the variability of its evaluation factors is a multi-process, when forming a final conclusion about the effectiveness of the construction enterprise, it is necessary to make a conclusion on each of the indicators of the factors under consideration, some of which lead to corresponding risks during the implementation of construction [1]. Therefore, insufficient attention to the assessment of risk factors in the activities of construction enterprises can cause irreversible consequences and increase the cost of project implementation.

Risk management is a difficult and complex process that requires accurate data. Therefore, the choice of an effective method for assessing risk factors plays an important role at the planning and implementation stages of investment and construction projects [2–3].

The purpose of this study is to develop a method for assessing the risk factors of construction activities using the theory of evidence [4].

There are various approaches to assessing the risk factors of investment and construction projects. The traditional quantitative assessment method is the probability and impact matrix [5].

To visualize the risk factors, a matrix is created (Table 1), in which all risks are divided by their probability and impact.

Input data in the process of evaluating the probability of occurrence and impact of risk events using the probability and impact method is always associated with uncertainty.

Statistical analysis is used to determine the weighted values of the probability of occurrence and the degree of influence of factors (Table 2).

The responses of the sample participants are converted from qualitative values to numerical values in such a way that they can be easily processed by statistical analysis methods [8].

This study took into account organizational, technical, economic, environmental, and safety and quality factors.

Formula (1) is used to determine the relative importance of each of the factors studied:

$$R_i = \frac{\sum(\text{Number of category responses} \times \text{Period center})}{\text{Total number of responses}}.$$

It should be noted that there are certain requirements for the expert opinion. It must be reliable and justified, and the assessment of the factor depends on it.

The statistical method can be used to model uncertainty, which is its main advantage. The disadvantages of statistical analysis include: the lack of objective expert opinion, the need for highly qualified specialists to conduct a survey.

In order to solve these problems, this paper proposes a method based on the Dempster-Shafer evidence theory [9]. This method, unlike statistical analysis, does not require an expert survey and makes the proposed model scalable [9–10].

The Dempster-Shafer theory is a generalization of the Bayesian theory of subjective probability. It has the relative flexibility to allow for uncertainty and the ability to combine evidence from multiple sources.

The Dempster-Shafer theory has been applied in various fields of science and has shown promising results. For example, Basir and Yuan [11] used the Dempster-Shafer theory to diagnose engine failures, and Wahaband Otrok and Mourad [12] proposed a Dempster-Shafer based model for detecting bad vehicle behavior.

An important aspect of the theory under consideration is the combination of evidence obtained from several sources and the modeling of a conflict between them. In addition, this approach solves the problem of confidence measurement [13]. This theory was originally presented by Dempster, and then Shafer completed it in his book “Mathematical theory of proofs” [14]. In this theory, the scope of the problem is determined using a non-empty set of bounded and mutually exclusive hypotheses, called a distinction system, which is defined as follows:

$$\theta = (\theta_1, \theta_2, \ldots, \theta_n).$$

The main probability assignment or mass function (confidence measure) is a function represented as 2Θ in the interval [0; 1], so that m {Θ} = 0, where Θ is an empty set and

$$\Sigma m(A) = 1.$$

In the Dempster-Shafer evidence theory, the Dempster combination rule is symbolized by the operator $\oplus$ and is used to combine two different sources of evidence [15]. In other words, this operator can be used to combine two proofs, such as m_1 and m_2 [4–15]:

$$m_{1,2}(A) = (m_1 \oplus m_2)(A) = \frac{\sum B \cap C\{m_1(B), m_2(C)\}}{1 - K},$$

where $A \neq \varnothing$ and $m(\varnothing) = 0$.

K is calculated by multiplying each proof in addition to this proof:

$$K = \sum_{B \cap C = \varnothing} \{m_1(B), m_2(C)\}.$$

In these relationships, *K* is the balancing factor. It is also called a contradiction factor, because it indicates the degree of contradiction between two sources of evidence.

When applying the Dempster-Shafer evidence theory for risk factors assessment, the first step is to determine judgments [16]. In the presented model, each judgment characterizes the degree of reliability of the evidence for the corresponding risk factor, which is a real number in the range [1; 5].

In the case, there are only two possible values, so it is necessary to combine two proofs. The second step in using the Dempster-Shafer evidence theory is to determine the proofs [16]. The impact and probability are considered as evidence of the final value of the risk factor.

The third step in using the Dempster-Shafer evidence theory is to define the mass function. For this purpose, the normalized impact and probability values are used as follows:

$$m(A) = \frac{f_i - F_{\min}}{F_{\max} - F_{\min}},$$

where $(f_i) \in [1; 5]$ and has upper and lower limits of risk factor assessment forms.

After finding the probability using formulas (4), (5), the total review score is calculated by converting the aggregated mass (*m*) to five points ($F_{\max}$) using the following formula:

$$P_{\text{пм}} = \{(m \times 4) + 1\}.$$

To see a practical example of applying the proposed method to obtain a risk factor value, let's assume that the impact and probability estimates have values of 3.5 and 1.25, respectively.

Based on these two values and according to formula (6), $m_1(A)$ and $m_2(A)$ are 0.625 and 0.0625, respectively. Now these two values can be aggregated using formulas (4) and (5) as follows:

$$K = \sum_{B \cap C = \varnothing} \{m_1(B), m_2(C)\} = 0.625 \times (1 - 0.0625) + 0.0625 \times (1 - 0.625) = 0.6094,$$

$$m_{1,2}(A) = (m_1 \oplus m_2)(A) = \frac{0.625 \times 0.0625}{1 - 0.6094} = 0.1,$$

$$P_{\text{пм}} = \{(0.1 \times 4) + 1\} = 1.4.$$

Construction enterprises focused on solving tactical tasks, produce a classification, ranking and appropriate research of risk factors that cause various risks at all stages of construction industry, using various scientific methods and methodological tools for statistical processing of information [17].

Risk factors that affect the sustainable operation of construction companies can be divided depending on the level and nature of their impact on the following groups:

1) the design factors (affect the achievement of project goals);
2) business factors (affect operating activities);
3) environmental factors (external to the project, may affect the project goals);
4) internal factors of each participant in the construction chain.

There are several types of risk factors that are well studied and analyzed [18–19]:

1) organizational factors arising from organizational plans for project implementation;

2) labor and technical factors related to human resources and mechanisms;

3) political and safety factors: these are factors that arise as a result of political changes and the safety environment;

4) economic factors – factors related to financial allocations and obstacles that may arise in this area;

5) legal factors – factors that arise as a result of violations of contractual obligations and laws.

The results of assessing the importance of risk factors were obtained using a questionnaire (table 2) conducted among experienced specialists. The factors that cause risks are analyzed using the formula (1) and in accordance with the results are presented in the ninth and tenth columns of Table 3.

The last two columns of table 3 reflect the assessment of risk factors using the proposed Dempster-Shafer evidence theory. As mentioned earlier, several steps are required to evaluate the risk factors using this method. At the first stage, judgments are determined. In the second stage, probability and impact are considered as two proofs for each event and their mass functions are presented according to the formula (6). After that, formulas (4) and (5) are applied to combine their mass functions, which show the factor estimation indicated in the ninth column of Table 3.

Fig. 1 and 2 graphically show the ranks of risk factors determined using traditional, statistical and proposed methods.

Summarizing the above, it can be stated that the Dempster-Shafer evidence theory and statistical analysis are the most effective and applicable methods for modeling uncertainty in the process of evaluating risk factors. The main drawback of statistical analysis is the lack of objective expert opinion on risk factors. The Dempster-Shafer evidence theory overcomes this disadvantage. The DS method has several advantages over probabilistic methods, since it does not require a preliminary probability. The computational complexity of the Dempster-Shafer evidence theory is less than that of the statistical method. In addition, it has a flexible and easy to use mass function.

The proposed model is used to evaluate the current risk factors of investment construction

Table 3. Comparative analysis of risk factors assessment using various methods

Symbol	Risk factor	Probability	Impact	Traditional method		Statistical method		Proposed method	
				Factor	Rank	Factor	Rank	Factor	Rank
s_1	Incongruity of purchased land plots with the permitted type of construction	1.9	3.8	7.22	16	2.11	20	2.62	14
s_2	Lack of necessary equipment and mechanisms for construction and installation works	3.05	2.1	6.405	20	3.16	7	2.14	20
s_3	Lack of material (territorial) resources	3.2	4.1	13.12	5	3.58	4	4.23	4
s_4	Violation of terms of delivery of materials	2.35	1.8	4.23	25	2.05	21	1.45	25

Table 3. Comparative analysis of risk factors assessment using various methods

Symbol	Risk factor	Probability	Impact	Traditional method		Statistical method		Proposed method	
				Factor	Rank	Factor	Rank	Factor	Rank
s_5	Low qualification of labor resources	3.5	4.1	14.35	2	3.86	2	4.41	2
s_6	Non-compliance with labor safety rules	2.4	3.65	8.76	9	2.39	12	3.06	10
s_7	Bankruptcy of subcontractors	1.9	3.4	6.46	19	1.95	24	2.21	18
s_8	Unlettered planning of production and financial activities	2.5	2.05	5.125	21	2.23	15	1.70	21
s_9	Changes to requirements in the legal framework	1.6	2.9	4.64	24	2.0	22	1.55	23
s_{10}	Delay in passing the project examination, refusal to obtain a permission for construction	2.1	3.6	7.56	13	2.12	19	2.65	13
s_{11}	Unstable political situation	2.3	3.6	8.28	10	2.15	17	2.89	11
s_{12}	Significant change to the terms of the contract	3.4	3.5	11.9	7	2.74	10	3.86	8
s_{13}	Insufficient control of technical supervision	2.0	3.75	7.5	14	2.25	14	2.69	12
s_{14}	Bureaucratic cost	1.55	2.7	4.185	26	1.98	23	1.42	26
s_{15}	Non-compliance with Russian Government regulations	1.8	2.15	3.87	27	2.2	16	1.37	27
s_{16}	Terrorist activities and crime	3.1	2.5	7.75	12	1.84	26	2.59	15
s_{17}	Delayed payment of wages	3.15	3.8	8.17	11	3.95	1	3.92	7
s_{18}	Technical glitches in the transfer of funds	2.8	2.35	6.58	18	2.40	11	2.18	19
s_{19}	Lack of own financial resources	2.9	3.9	11.31	8	3.18	6	3.82	9
s_{20}	The insolvency of consumers	1.45	3.05	4.42	23	2.34	13	1.54	24
s_{21}	Errors in project documentation	3.8	3.16	12.008	6	2.85	9	3.93	6
s_{22}	Significant changes in design documentation	1.85	3.65	6.7525	17	2.14	18	2.39	17
s_{23}	Late changes to the design documentation	3.1	2.4	7.44	15	1.87	25	2.49	16
s_{24}	Environmental pollution, ecological damage	3.4	3.9	13.26	4	2.95	8	4.19	5
s_{25}	Non-compliance with legislation in the field of environmental protection	1.8	2.75	4.95	22	1.32	27	1.65	22
s_{26}	Climate conditions	3.4	4.05	13.77	3	3.55	5	4.31	3
s_{27}	Equipment malfunction and emergency situation	3.9	4.25	16.575	1	3.79	3	4.68	1

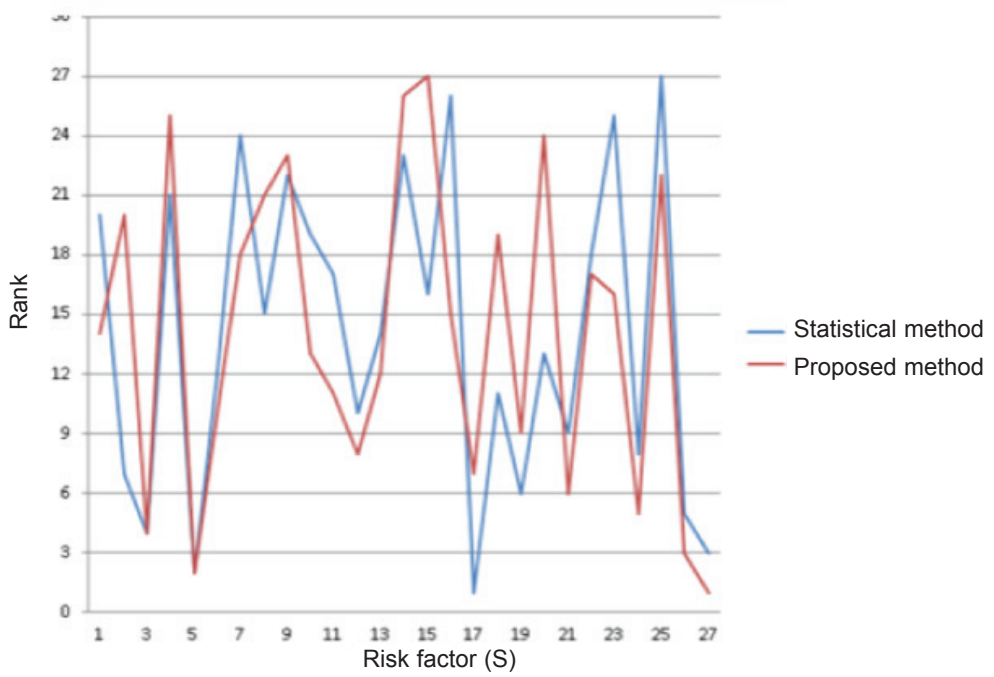

Fig. 1. Ranking factors using statistical and proposed methods

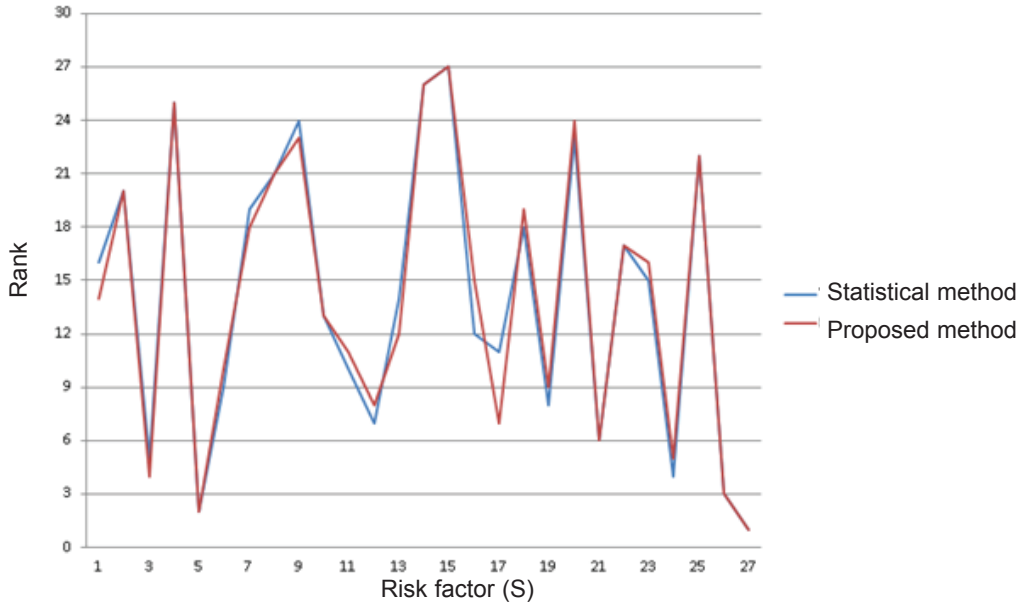

Fig. 2. The ranking of factors using the traditional and proposed methods

projects that are pre-defined and entered in a special questionnaire and takes into account the uncertainty in the process of evaluating them.

For the greatest reliability of the study, a comparative analysis of the results of evaluating construction risk factors obtained using various methods (traditional, statistical, method based on the Dempster-Shafer evidence theory) was carried out.

Using Spearman's correlation coefficient, which shows the correlation between two ordinal

variables, a correlation was established between the proposed method and other similar methods (traditional and statistical).

The correlation coefficient of the risk rating between the proposed and traditional methods is 0.987. This coefficient indicates that there is a direct correlation between the results of the proposed and traditional methods.

The Spearman correlation coefficient of the risk factor rating between the proposed and statistical methods is 0.71. This means that there is an average correlation between the results of the proposed and statistical methods.

Assessing construction projects under conditions of uncertainty is an important issue in the field of construction risk management [4; 19–20]. The theory of DS proofs allows us to solve this problem effectively.

When applying the Dempster-Shafer evidence theory, it should consider the possibility of conflicts between the proofs, since this can lead to unreliable results. In this regard, the development of a modified method using the Dempster-Shafer evidence theory to assess the risk factors and risks of an investment construction project in cases where there are conflicts between evidence is a priority for further research.

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Формирование модели оценки рискообразующих факторов, влияющих на устойчивое функционирование строительных предприятий

И.Л. Абрамов, З.А. Аль-заиди

ФГБОУ ВО «Национальный исследовательский Московский государственный строительный университет», г. Москва (Россия)

Ключевые слова и фразы: риск; рискообразующие факторы; статистический метод; строительные предприятия; теория Демпстера-Шафера.

Аннотация. При реализации инвестиционных строительных проектов возникает большое количество рискообразующих факторов. Данные факторы способны оказывать воз-

действие на устойчивое функционирование строительных предприятий и вызывать такие риски, как нарушение сроков сдачи объекта в эксплуатацию, возникновение незавершенного строительства, повышение себестоимости и низкое качество выпускаемой продукции. В связи с этим поиск и обобщение методов оценки рискообразующих факторов, оказывающих воздействие в том числе на устойчивое функционирование строительных предприятий при реализации инвестиционных проектов, приобретает особую актуальность.

Цель настоящего исследования заключается в разработке на основе теории Демпстера-Шафера модели для оценки рискообразующих факторов, возникающих в ходе реализации инвестиционного строительного проекта и вызывающих риски. Для реализации поставленной цели решаются следующие задачи: проводится анализ существующих методов оценки строительных рисков (традиционного, статистического (среднее арифметическое)); описывается процесс оценки рискообразующих факторов при помощи математической модели на основе теории Демпстера-Шафера; производится сравнение рассмотренных методов оценки рисков, выявляются их преимущества и недостатки. Гипотеза исследования заключается в предположении о том, что теория доказательств Демпстера-Шафера является эффективным инструментом, позволяющим сформировать модель для всесторонней и углубленной оценки рискообразующих факторов, препятствующих успешной реализации инвестиционно-строительного проекта. В результате исследования установлено, что между исследуемым методом оценки и другими аналогичными методами (традиционным и статистическим) существует корреляционная зависимость. Главное преимущество предложенного метода оценки заключаются в том, что он облегчает поиск оптимальных управленческих решений в условиях риска и неопределенности.

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UDK 69

Identification and Assessment of Risk Factors During Planning the Production Activities of a Construction Enterprise

I.L. Abramov, Al-zaidi Zaid Ali Kadhim

National Research Moscow State University of Civil Engineering, Moscow (Russia)

Key words and phrases: analytical tools; Ishikawa diagram; Pareto chart; spread chart; risk factors; construction company; construction production.

Abstract. The purpose of this article is to find effective ways to assess the risk factors that affect the technical and economic indicators of construction production. For implementation of this goal, the following tasks were performed: a Pareto chart, Ishikawa and scatter diagrams were used to identify and analyze risk factors in construction production. The research hypothesis is based on the assumption that the studied analytical tools allow predicting construction risks, as well as correcting the level of probability of their occurrence, so taking timely measures to prevent or minimize risks. The following methods were used in the research – a description method, classification method, comparison method, analysis method, synthesis method. The results of the study confirmed that with the help of the considered tools used by a construction enterprise in conditions of uncertainty during planning its production activities, it is possible to determine the probability of various construction risks and take the necessary corrective actions.

Identification of possible risks is one of the priority activities for the implementation of an investment – construction project. Even at the project planning stage, it is necessary to take into account the likelihood of adverse situations that cause deviations from the normal course of construction, and choose ways to manage these situations, assess possible risks and provide expenses for measures to prevent or eliminate them. The quality of the final construction product depends on proper identification and risk assessment. The number of risk factors largely depends on the level of uncertainty, the type of investment – construction project and its interaction with the environment, the impact of various natural and man-made sources.

As practice shows, various analytical tools are most often used for forecasting and assessing risks, which allow for the appropriate analysis through statistical data processing. These tools are easy to understand and are characterized by a fairly high degree of development.

This article discusses analytical tools that allow to graphically display the factors that

Table 1. Recording of project risk factors within one month

Risk factors	Frequency	Cumulative frequency	Accumulated percent, %
1. Disruptions in the supply of materials	22	22	37
2. Receipt of low-quality material	15	37	62
3. Violation of labor discipline	10	47	78
4. Errors in design documentation	5	52	87
5. Non-compliance with quality requirements for construction – installation works	4	56	93
6. Errors in geodetic works	4	60	100

affect the production activity of a construction enterprise during implementing an investment - construction project.

A Pareto chart it is a histogram (bar chart) that shows the relative frequency of events. It allows identifying problems and risks that need to be addressed based on the data available about the construction project. First of all, the factors that cause risks are identified, then statistical material is collected for each factor. The obtained statistical information is processed and a table is compiled that reflects the frequency of occurrence of certain factors (table 1).

Then, we build a bar chart, placing factors (columns) according to the degree of decrease, depending on the frequency of their occurrence. Thus, the Pareto chart can be used to assess the factors that affect the implementation of an investment – construction project, and direct main efforts to prevent or eliminate the most significant of them [1–3]. In other words, the considered diagram allows distributing the effort to fix problems in proportion to their importance.

The basic Pareto rule states that 80 % of problems are related to 20 % of causes, and therefore 20 % of problems are related to 80 % of causes.

For example, the diagram shown in Fig. 1 shows that two risk factors cause about 80 % of the problems. These factors contribute to the emergence of such risks as:

1) violation of the terms of production work;
2) decrease in the quality of products;
3) going beyond funding.

In this regard, the construction enterprise, subcontractors, and other construction participants should first focus on reducing the level of occurrence of these risk factors.

The Ishikawa diagram (cause-and-effect diagram)expresses the relationship between the influence of risk factors and the quality of the final product. These factors are shown on a diagram that resembles a fish in shape, so it is often referred to as a “fish skeleton”.

The diagram shows the causal relationship between factors and their negative consequences that affect the final result. The process of constructing a cause-effect diagram consists of several stages [3]:

1) selecting the object (process) which is necessary to analyze;
2) selecting factors that affect the object (material, technical and labor resources, methods,

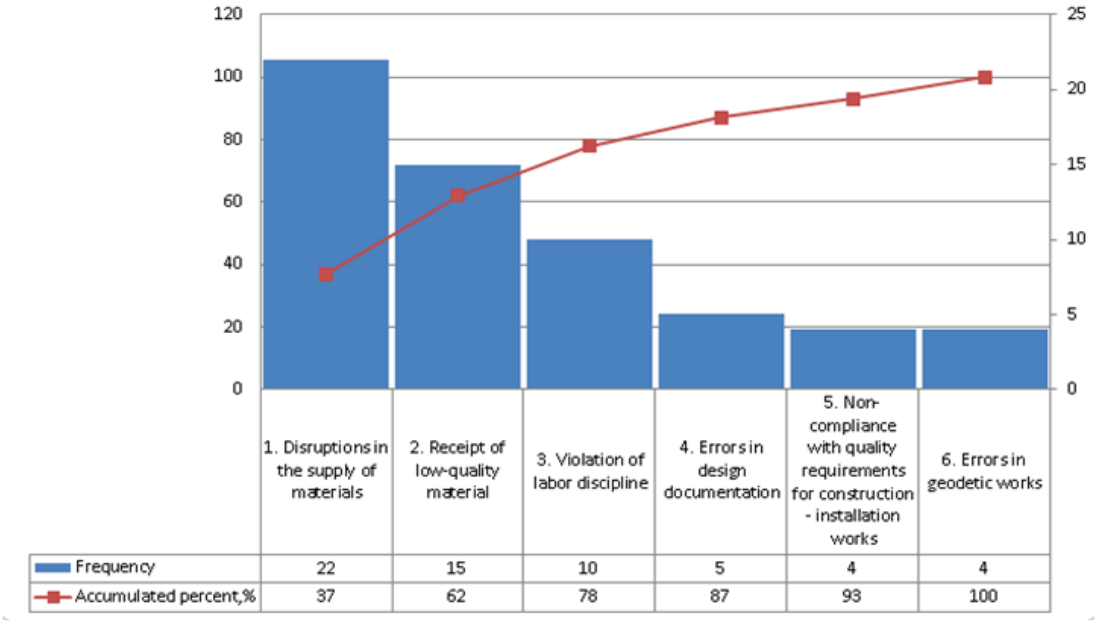

Fig. 1. Pareto chart

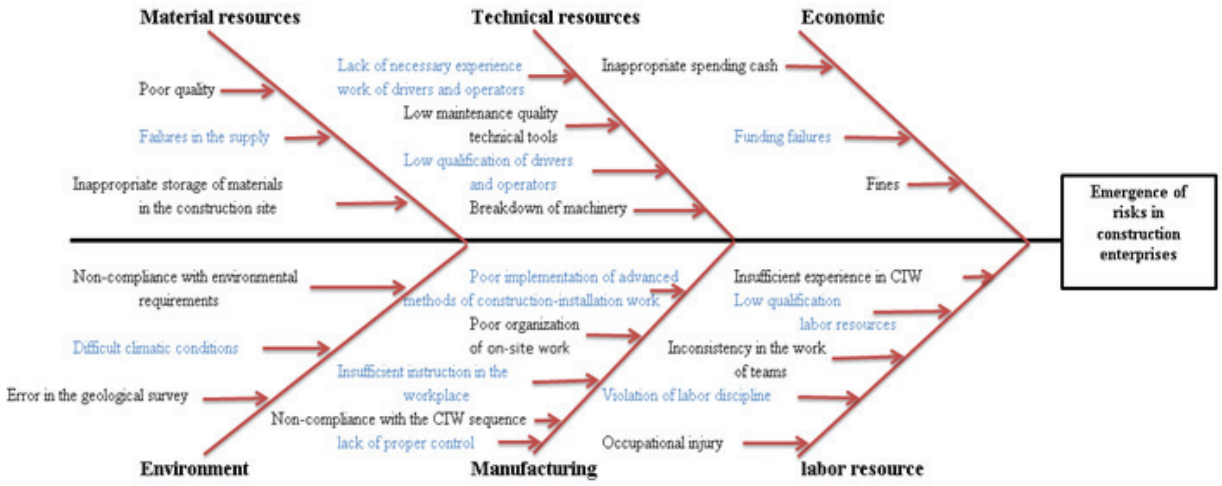

Fig. 2. Diagram of factors and sub-factors of construction risks

environment, technologies, etc.);

3) building a diagram by grouping factors into semantic and causal blocks (technical, natural, economic, etc.);

4) decomposing each factor into smaller “secondary branches” with the designation of sub-factors;

5) checking the logical connection of each chain.

The main stage of the research methodology is to identify the factors that cause risks. Risk management specialists should have the skills to identify and evaluate such factors.

The Ishikawa diagram allows you to create a complete picture of the impact of risks and their consequences on the activities of construction companies, to determine the true causes of

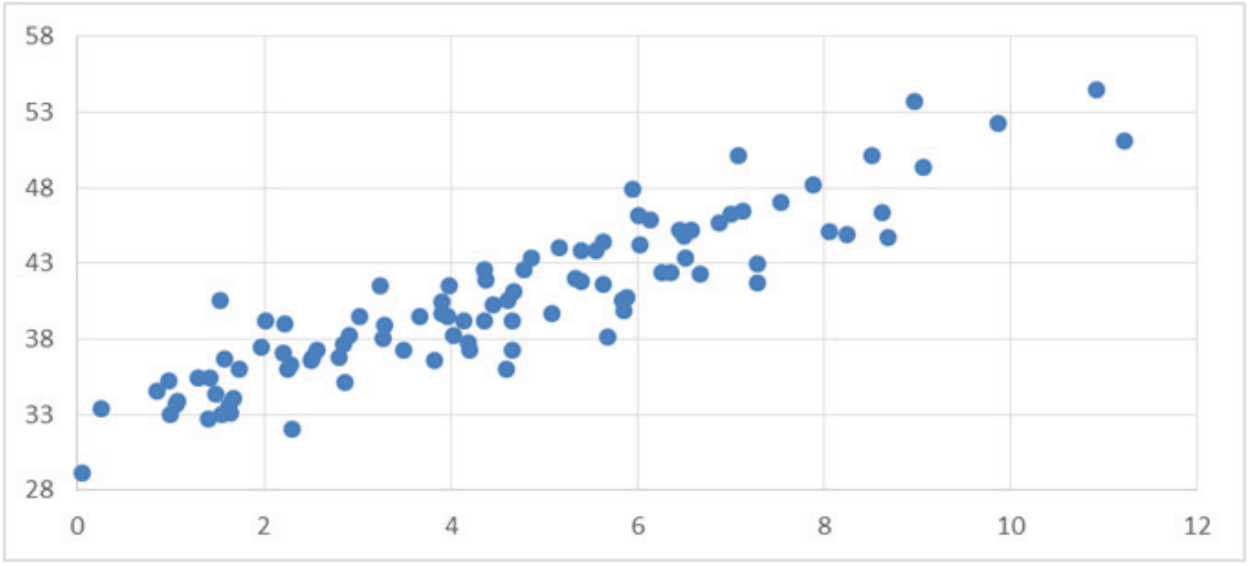

Fig. 3. The Scattergram [1]

risks and make the necessary organizational and managerial decisions [4; 5].

The Fig. 2 shows an example of systematization of the identified set of destabilizing factors and their causal relationships are determined [6].

Scattergram (dispersion) allows determining the relationships between two variables that affect the production process, and to improve the quality of this process in a timely manner. Further, the diagram shows the form of the relationship between variables (positive or negative) and the degree of this relationship (strong or weak) (Fig. 3).

The following types of such a relationship can be distinguished:

1) a strong positive relationship(for example, increasing level of productivity using incentive measures);

2) a strong negative relationship (for example, violation of the deadlines for completion of construction with the bad weather);

3) a weak positive relationship (for example, increasing level of productivity with improving the quality of services);

4) a weak negative relationship (decrease in productivity with increasing working hours);

5) a curved line of relationship (high cost of construction work with a critical time of their completion);

6) lack of communication.

Thus, the considered analytical tools used by a construction enterprise in the conditions of uncertainty when planning its production activities, allows you to determine the causes of risks, to rank risk-forming factors by degree of significance, to predict the consequences of the occurrence of risk events and take timely measures to prevent or eliminate them. To achieve the greatest effect, recommend use multiple charts together.

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Идентификация и оценка рискообразующих факторов при планировании производственной деятельности строительного предприятия

И.Л. Абрамов, Аль-Заиди Заид Али Кадхим

ФГБОУ ВО «Национальный исследовательский Московский государственный строительный университет», г. Москва (Россия)

Ключевые слова и фразы: аналитический инструментарий; диаграмма Исикавы; диаграмма Парето; диаграмма разброса; рискообразующие факторы; строительное предприятие; строительное производство.

Аннотация. Целью настоящей статьи является поиск эффективных способов оценки рискообразующих факторов, влияющих на технико-экономические показатели строительного производства. Для реализации поставленной цели были выполнены следующие задачи: рассмотрено применение диаграмм Парето, Исикавы и разброса (рассеивания) для выявления и анализа рискообразующих факторов строительного производства. Гипотеза исследования заключается в предположении, что изученный аналитический инструментарий позволяет прогнозировать строительные риски, а также корректировать уровень вероятности их возникновения, т.е. принимать своевременные меры по предотвращению или минимизации рисков. В процессе исследования применялись следующие методы: метод описания, метод классификации, метод сравнения, анализ, синтез. Результаты исследования подтвердили, что при помощи рассмотренного инструментария, используемого строительным предприятием в условиях неопределенности при планировании своей производственной деятельности, можно определять вероятность возникновения различных строительных рисков и предпринимать необходимые корректирующие действия.

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Digital Modeling in the Design of Buildings of Non-Retrospective Stylistics in Russia at the Beginning of the 21stCentury

I.V. Yamshanov, T.H. Ablyazov

Peter the Great St. Petersburg Polytechnic University;
St. Petersburg State University
of Architecture and Civil Engineering,
St. Petersburg (Russia)

Key words and phrases: architecture; BIM technology; design; digital modeling; neo-retrospectivism.

Abstract. At the beginning of the 21st century, architects turned to architectural images of past historical periods and buildings under construction began to acquire the features of traditional architectural styles, which was called neo-retrospective stylistics. The objective of this study is to consider this style. In the framework of neo-retrospectivism, the authors of the article highlighted a number of stylistic trends, among which are Neo-Russian, Neo-Byzantine, Neo-Roman, Neo-Gothic, Neo-Renaissance, Neo-Baroque, Neoclassicism, Neo-Modern, Neo Art Deco, Stalinist Neoclassicism, etc. Another trend inherent in the construction industry as a whole, and neo-respective buildings in particular is the gradual transition from two-dimensional drawings and three-dimensional models to modern digital modeling technologies (**BIM**). In this article, the authors substantiated the relevance of using BIM in the implementation of projects in a non-retrospective style, and also assessed the possible benefits of using digital modeling when referring to traditional architectural styles.

The retrospective direction of architecture at the beginning of the 21st century is experiencing a new period of prosperity. Traditional architectural forms, which, as it seemed earlier, were already forever in the past, were again in demand. Neo-retrospectivism of the 21st century is a stylistic trend that again draws our attention to the architectural expressiveness of buildings by applying architectural concepts of earlier historical periods. Currently, non-retrospective style has proved to be particularly popular and in demand in the design and construction of private country houses. Moreover, low-rise residential complexes, as well as medium-rise complexes, also often have features of traditional style architecture in their appearance. A number of modern hotel complexes have similar characteristics.

At the present stage of development of the construction sector, it is almost impossible to imagine the process of building design without the use of modern digital technologies.

Their widespread penetration did not leave aside projects made in a non-retrospective style. In recent decades, architectural design is in the transition stage from a man-made and highly professional approach to automated and digital [1]. Unfortunately, often the issues of artistic and compositional approach are considered only when designing unique buildings, while many other objects are built using standard solutions, sometimes without the involvement of an architect.

The main direction of development of digital technologies in the field of construction is building information modeling (BIM, BIM-technologies, digital modeling), which is a platform for interaction between architects, builders and users of the object, containing detailed information about each element, system and structure of the building [2]. Within the framework of BIM, a virtual 3D model of a building is created, which is used both at the architectural design stage and during the implementation of all conceived solutions. The main difference between BIM and previous design options, for example, in AutoCAD, is that BIM creates a complete digital model of the building with all engineering networks and systems.

In our opinion, the growing interest in buildings of non-retrospective style is one of the factors contributing to the spread of BIM, since their construction is associated with the implementation of complex and unique architectural elements, the design of which is most optimally carried out using digital building modeling technologies. Moreover, in the modern world, the issues of functionality and comfort of buildings are also important, and the use of digital technologies, in particular BIM, will allow you to implement projects of a non-retrospective style, taking into account both the features of this style and modern requirements for living comfort.

In general, the implementation of a construction project goes through three enlarged phases of the life cycle – design, construction and management of the finished real estate object [3]. Despite the fact that BIM implies the integrated use of information contained in the building model, the development of digital modeling began with specialized architectural versions of programs and their new architectural sections [4].

From the point of view of architectural design, the main advantages of BIM technologies are more accurate conceptualization and visualization of the project at the early stages of design, increasing the analyzed set of planned technologies for application, reducing design time due to automation, reducing the number of design errors, simplifying the process of interaction with customers and project performers, as well as improving the quality of project documentation [5]. Surveys of Russian companies have shown that 72 % of organizations have improved their understanding of the project when using BIM, almost a third of respondents (61 %) have accelerated the process of transmitting information, and 46 % have noted a reduction in design time [6]. It is the accumulation of experience with BIM and the expansion of the list of items in the element libraries that allows us to achieve such positive effects from designing with BIM.

Currently, scientists are considering a variety of digital technologies, studying their relationship with mathematical modeling, deepening research in the field of digital technologies in the production of materials, products and structures, computer materials science [7]. One of the features implemented with the help of BIM is the assessment of energy efficiency of the designed building, and the results of calculations look clear and clear even for customers who do not have special knowledge in the field of construction [8]. Moreover, the future owner can take a virtual tour of the building and evaluate its energy consumption at different times of the year and periods of the day [8].

In addition to digital modeling, a new principle of building construction using a 3D printer is being studied, and the “printing” process can be performed using various technologies that have their own advantages and disadvantages, which generally affects the characteristics of structures built using 3D printers [9; 10].

Fig. 1. A 3D model of Garibaldi's Castle in the Village Khryashchevka, the Samara region

Thus, at present, an increasing number of objects are designed and built not using two-dimensional design, but on the basis of BIM technologies. Non-retrospective stylistics are directly related to unique architectural elements, non-standard building layout, and the use of digital modeling technologies when working with such objects will allow you to prepare better project documentation, as well as allow you to calculate all the project costs taking into account the smallest features of the building, which will eventually lead to an improved understanding of the construction concept by other project participants, it will also become the basis for the most accurate implementation of all architectural solutions in order to preserve the stylistic identity of the building.

We consider the stylistic features of modern neo-retrospective architecture. Within the framework of neo-retrospectivism, the following stylistic trends can be distinguished: neo-Russian, neo-Byzantine, neo-Roman, neo-Gothic, neo-Renaissance, neo-Baroque, Neoclassicism, neo-modern, neo-art Deco, Stalinist Neoclassicism, as well as some other styles (neo-Rococo, Chinese style, Norman style, eclecticism).

Neo-gothic of the beginning of the 21st century, as well as in previous periods of development [11; 12], is quite diverse. Both various medieval styles and romanticized neo-Gothic of the 19th century are imitated. Projects often feature eclectic combinations of Gothic with other architectural styles.

One of the most notable examples of modern retrospective architecture is the Garibaldi castle, which was built in the village of Hryashchevka in the Samara region and is a hotel and local landmark (Fig. 1). The building was built in the neo-Gothic style, and digital modeling was used most actively in its design.

Within this unique structure, the architecture of several time periods was imitated: starting from the late Romanesque style, continuing with early, Mature and flaming Gothic, and ending with elements of stylistic restoration of the 19th century. The castle has a complex asymmetric

Fig. 2. A 3D model of the mansion in neo-Renaissance style (Antica Company)

three-dimensional structure.

Note that neo-retropectivism is also inherent in private country houses, various design organizations in recent years have offered a huge number of various projects using traditional architectural forms. In most cases, preference is given to neo-Renaissance, neoclassical or neo-architectural styles, if the building imitates Palace architecture. If the architecture of the castle is reproduced, the Romanesque and Gothic styles are used, respectively, in some cases with elements of half-timbered architecture. Modern half-timbered houses in their appearance are closest to the historical stylizations of the 19th century. Buildings of the neo-Russian style represent reminiscences on the theme of Russian wooden and stone architecture.

Buildings in the neo-Renaissance style can be equally symmetrical with volume-planning construction, and with asymmetric (Fig. 2). Modern buildings in the Renaissance style can be an imitation of Italian Palazzi and French Chateaux. In this case, both order-based and non-order-based compositions are used.

Modern architecture of the Baroque style is characterized by the use of quite complex and pretentious planning solutions. Perhaps the most expressive example of neo-Baroque architecture embodied in the material is the Vasiliev Palace in Vyritsa near Saint Petersburg (Fig. 3).

The most famous example illustrating the use of forms of Stalinist classicism is the monumental residential complex in Moscow, called the Triumph Palace, which is the tallest residential building in Russia (Fig. 4).

As can be seen from the above examples, neurotropism involves the creation of complex architectural forms and decorative elements, so it is important to maximize use of BIM

Fig. 3. A general view of the Vasiliev Palace in Vyritsa near Saint Petersburg

Fig. 4. A 3D model of the “Triumph-Palace”residential complex

technology in the construction of objects that most closely match the original concept of the architect, as in the absence of unimportant, in the opinion of the layperson, elements of lost the final appearance of the building, which in this case is a bad example neurotrophins style.

The Bogatyr hotel in Sochi is an unfortunate example of using historical architectural forms. During the implementation of the project, the building lost most of the designed architectural

Fig. 5. A general view of the Bogatyr Hotel in Sochi

details that gave it a complete appearance (Fig. 5).

Currently, Russia is undergoing a gradual transition to BIM technologies in the design of buildings and structures. Initially, the task of implementing information modeling at all stages of the life cycle of capital construction projects was set by the order of the President of the Russian Federation No. PR-1235 dated July 19, 2018 [13]. Over the past period, the regulatory and technical framework for the implementation of BIM has been improved in terms of the development and introduction of codes of rules and GOST, as a result, in 2019; information modeling was fixed in the Urban Planning Code of the Russian Federation [14]. The legislative consolidation of BIM in Russia has officially provided a legal basis for the dissemination of BIM by introducing the concepts of information model and information modeling, classifier of construction information, and establishing the powers and responsibilities of urban planning entities in relation to the exchange of necessary information about the project [15].

Therefore, previous versions of digital modeling, which did not fully reflect the internal structure of the building, must now give way to modern BIM technologies, and all conditions are created for this. The use of BIM technologies in the construction of buildings with a non-retrospective style is particularly important due to the fact that, as a rule, such projects have a lot of complex architectural decorative elements. The more carefully this decor is modeled, the less it will cost to produce it during the project implementation. The higher the quality of the three-dimensional model, the more accurate the calculation of material costs for the implementation of the project, which becomes especially important in the implementation of construction work, when the project has a bright personality, or even unique in its kind.

Often, when implementing a project, the cost of construction work exceeds the cost originally included in the estimate documentation, which is associated with many different factors, and in the case of implementing a building project in a non-retrospective style may lead to an attempt to save on decorative details that are quite expensive to manufacture. Such attempts to save money lead to a catastrophic distortion of the architectural appearance of the object being created. This is what happened to the Bogatyr hotel in Sochi (Fig. 5–6).

It should be noted that BIM is mainly used in new construction and much less often-for

Fig. 6. A project of the Bogatyr Hotel in Sochi

constructed buildings [16; 17]. In the world practice, there is even a separate direction of Historic Building Information Modeling (H-BIM), the main purpose of which is to preserve cultural heritage [18; 19], but the data obtained during the creation of digital models can also be applied to the construction of buildings of non-retrospective style, taking as a basis the elements added to the library.

In the design and construction of buildings in the retrospective direction, laser scanning technologies can be used simultaneously with BIM [20]. As an example of using this technology, you can scan individual decorative details of a historical architectural monument in order to further apply them in a new object as an architectural quotation, which can be especially relevant when reproducing a sculptural decoration.

Thus, at present, the architectural appearance of suburban housing construction, as well as low - and medium-rise construction, acquires the features of a non-retrospective style, gradually moving away from the typification of projects. As a result of the research, the authors identified stylistic trends of neo-retrospectivism that are characteristic of housing and hotel construction, including neo-Russian, neo-Byzantine, neo-Roman, neo-Gothic, neo-Renaissance, neo-Baroque, Neoclassicism, neo-modern, neo-art Deco, Stalinist Neoclassicism, as well as some other styles (neo-Rococo, Chinese style, Norman style, eclecticism).

From the point of view of designing in a non-retrospective style, an important direction of development is to spread the practice of using BIM technologies both for the purpose of recreating complex and unique architectural elements based on digital models of existing architectural monuments, and in General to optimize the project implementation process. The use of modern computer programs such as 3DS Max, AutoCAD, ArchiCAD, Revit architecture, as well as a number of others allows you to significantly improve the design process.

In conclusion, the lack of a complete three-dimensional model of the building created by digital modeling can cause costs to increase due to a lack of understanding of the project

and subsequently lead to the rejection of architectural elements in order to save money. This situation is quite common in Russian construction practice, but in the case of buildings with a non-retrospective style, failure to implement the architectural concept of the project leads to the loss of the aesthetic qualities of the object and the violation of the stylistic component, resulting in the building becoming an unsuccessful attempt to combine modern housing construction with classic images of architecture.

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Цифровое моделирование при проектировании зданий неоретроспективной стилистики в России в начале XXI в.

И.В. Ямшанов, Т.Х. Аблязов

ФГАОУ ВО «Санкт-Петербургский политехнический университет Петра Великого»;
ФГБОУ ВО «Санкт-Петербургский государственный архитектурно-строительный университет»,
г. Санкт-Петербург (Россия)

Ключевые слова и фразы: проектирование; архитектура; цифровое моделирование; BIM-технологии, неоретроспективизм.

Аннотация. В начале XXI в. архитекторы вновь обратились к архитектурным образам прошлых исторических периодов, и строящиеся здания стали приобретать черты традиционных архитектурных стилей, что получило название неоретроспективной стилистики. Задачей данного исследования является рассмотрение данной стилистики. В рамках неоретроспективизма авторами статьи выделен ряд стилистических направлений, среди которых неорусский, неовизантийский, неороманский, неготика, неоренессанс, необарокко, неоклассицизм, неомодерн, нео арт-деко, сталинский неоклассицизм и др. Еще одной

тенденцией, присущей строительной сфере в целом и неоретроспективным зданиям в частности, является постепенный переход от двумерных чертежей и трехмерных моделей к современным технологиям цифрового моделирования (BIM). В данной статье авторами обоснована актуальность использования BIM при реализации проектов в неоретроспективной стилистике, а также оценены возможные преимущества от применения цифрового моделирования при обращении к традиционным архитектурным стилям.

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Experimental Determination of the Long-Stroke Stage Feed Coefficient Using an Improved Lip Seal

S.S. Busarov, R.E. Kobylsky, I.S. Busarov, N.G. Sinitsyn

Omsk State Technical University,
Omsk (Russia)

Key words and phrases: cylinder-piston seals; experiment; feed rate; slow-speed stage.

Abstract. The slow-moving long-stroke piston stage is a unique object, which was developed by a group of authors from Omsk State Technical University. Increasing the productivity of this stage is one of the main subjects of research. In this paper, an experimental-comparative analysis of the feed rate of the piston stage using a standard lip seal with a feed rate using a selective lip seal is carried out. The results obtained indicate that when using a selective lip seal, the productivity of the piston stage increases significantly.

Introduction

Currently, on the basis of Omsk State Technical University, experimental studies are being conducted on the influence of the design parameters of the cuff seal on the tightness of the working chamber of a slow-speed long-stroke piston stage. It is known that the manufacturability of a compressor unit is characterized by a feed coefficient, which in turn determines the ratio of the actual capacity to the ideal [4]. The reduction in ideal performance occurs through gaps in the closed suction and discharge valves and through cylinder-piston seals. Each of these components requires separate study and research.

Research Object

The object of our research is the lip seals of a slow-speed long-stroke stage operating at the following parameters: cylinder diameter – 0.02 m; piston stroke – 0.05 m; gas temperature at the suction – 290 K; suction pressure – 0.1 MPa, discharge pressure 3–10 MPa; cycle time – 1…2 s, compressed medium – air.

Method of calculation

In [1], the authors performed static purging of seals to determine the effect of the design parameters of the lip seal on the tightness of the working chamber. During the experiment, it was found that the tightness of the working chamber is affected by: the opening angle of the cuff seal,

Fig. 1. General view of a slow-moving long-stroke stage

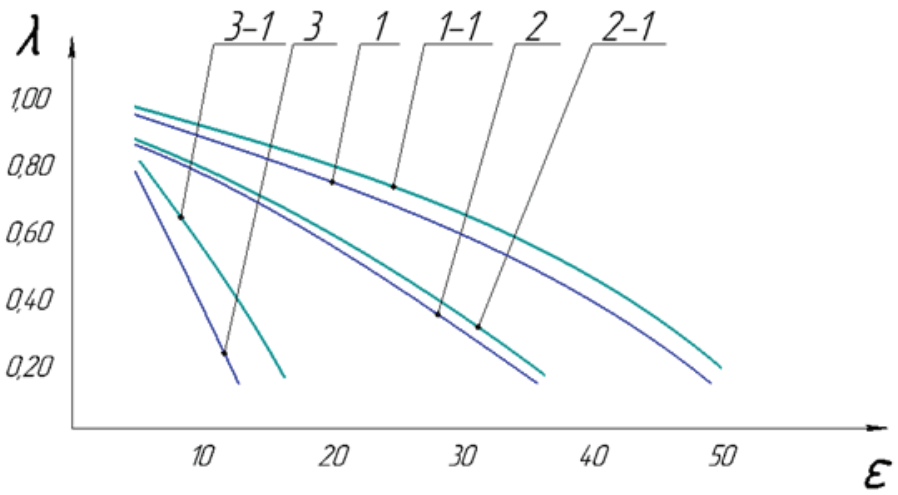

Fig. 2. Change in the feed rate from the degree of pressure increase at different cycle times:
1 – t = 1 s; 2 – t = 1.5 s; 3 – t = 2 s; 1, 2, 3 – standard lip seal;
1–1, 2–1, 3–1 – improved lip seal

as well as the diameter. The results obtained allowed us to determine the geometric parameters of the lip seal, in which leaks have the lowest values for the nominal diameter 20 mm. These parameters are the outer diameter 20.8 mm and the opening angle of the cuff 115°. In the comparative analysis, we used cuff seals (standard, according to the recommendations [5]) and the above-described cuff seals.

An experimental stand with a linear (hydraulic) drive has been developed for conducting experimental studies [2; 3].

Results

During the experiment, the dependence of the feed coefficient on the degree of pressure

increase was obtained when using a standard and selective lip seal (Fig. 2).

Conclusions and recommendations

The feed rate decreases from a value of 0.85 for a pressure increase of 50 to a value of 0.6 for a pressure increase of 30 for a cycle time of t = 1 s. If the cycle time is longer than 1 s, the stage performance at a pressure higher than 1 MPa decreases sharply. The use of a selective lip seal allowed increasing the feed rate (up to 0.95 with a pressure increase of 50) for each of the pressure increases. The maximum result was achieved for the cycle time t = 2 s, this is due to the fact that as the cycle time increases, the amount of gas that can leak increases, since the selective lip seal provides increased sealing of the working chamber, and the result will be the maximum for this cycle time.

It was experimentally proved that using a lip seal with an external diameter of 20.8 mm and an opening angle of 115°, it was possible to increase the performance (feed ratio) of the slow - moving stage.

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Экспериментальное определение коэффициента подачи длинноходовой ступени с применением селективного манжетного уплотнения

С.С. Бусаров, Р.Э. Кобыльский, И.С. Бусаров, Н.Г. Синицын

ФГБОУ ВО «Омский государственный технический университет», г. Омск (Россия)

Ключевые слова и фразы: коэффициент подачи; тихоходная ступень; цилиндро-поршневые уплотнения; эксперимент.

Аннотация. Тихоходная длинноходовая поршневая ступень является уникальным объектом, который разработала группа авторов Омского государственного технического университета. Повышение производительности данной ступени является одним из основ-

ных предметов исследования. В данной работе произведен экспериментально-сравнительный анализ коэффициента подачи поршневой ступени при использовании стандартного манжетного уплотнения с коэффициентом подачи при использовании селективного манжетного уплотнения. Полученные результаты свидетельствуют, что при использовании селективного манжетного уплотнения производительность поршневой ступени значительно возрастает.

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The Formation of an Approach to Attracting Customers in Cargo Transportation Process on Railway Transport

S.V. Ivanova, E.D. Molchanova, M.M. Polynskaya

Irkutsk State Transport University,
Irkutsk (Russia)

Key words and phrases: competitiveness; customer focus; customer satisfaction assessment; potential client; railway transport.

Abstract. The aim of the study is to focus on assessment performance indicators related to freight transportation at railway enterprises. The objective of the study is therefore to analyze the existing system for performance assessment of enterprises by quality parameters and offer evaluation criteria that provide for preventive measures in the provision of services. The article also presents the results of the analysis of the interaction of shippers and carrier organizations. In the study, general scientific methods were used. An algorithm for working with potential shippers, which provides for the formation of a database of the regional shippers, was designed and presented, an analysis of the trajectories of the movement of goods and determination of the required parameters for the transportation process by rail was conducted. Based on the studies and the presented results, a draft organization standard was formed in compliance with the proposed design model, which can be applied at any freight carrier enterprises in the field of railway transport.

Organizations depend on their customers and therefore must understand their current and future needs, meet their requirements, and strive to exceed their expectations

To evaluate the transportation process, there is a standard GOST R 51005-96 “Transport Services. Nomenclature of quality indicators”, which includes the most important requirements imposed by consumers to the services of all types of transport (Fig. 1) [4].

Within the framework of JSC “Russian Railways” as a network-wide cargo carrier, railway transport consumers have developed their own criteria for evaluating customer orientation, which are shown in Fig. 2 [2].

It should be noted that the transport services market is arranged in such a way that those who are actively working to attract customers have a stable increase in their number, and the rest, accordingly, lose customers.

The evaluation of the “customer turnover ratio” indicator is aimed at measuring and minimizing customer turnover, since customers are very vulnerable to competitors offering a

Cargo quality indicators		
Transportation timeliness	Safety of transported goods	Economic indicators
– timely transportation of cargo	– no parts missing	– specific cost of transportation by different modes of transport
– regularity of cargo transportation	– damage-free	– specific total cost of cargo transportation
– urgency of cargo transportation	– loss-free	– ratio of transportation costs and product costs (percentage)
	– contamination-free	

Fig. 1. Nomenclature of indicators of quality of transport services in the field of cargo transportation

Service quality indicators	Financial performance	Availability and flexibility indicators
Quality of the service provided (quality standards)	Customer's expenses related to transport services	Availability of services, ease of procedures for ordering services
Extensive service capabilities at the stages of preparation and provision of services	The amount of the tariff and fees for the provision of services	Distance of service centers from consumers
The timing of the review and approval of orders	Financial stability of the carrier	Availability of a portfolio of additional services
Quality control of suppliers' services (quality standards)	Financial stability of suppliers	Readiness to negotiate special conditions of carriage
Qualification of service personnel, service culture	Pricing flexibility	Ready to forward shipments EN route
Completeness of the service	Availability of a bonus system for attracting and retaining customers	Availability of information systems for remote access and electronic registration

Fig. 2. Main criteria for evaluating the customer-oriented indicators of the Russian Railways holding in the field of freight transport

"slightly" better product or service [8].

Evaluation of the "customer claims" indicator allows you to develop measures aimed at eliminating the cause of the claim. In this regard, special attention should be paid to the indicator "potential customer".

Evaluation of the "potential customer" indicator is necessary for market forecasting: an insufficient base of potential sales can lead to a decrease in the company's financial result.

The algorithm for working with potential clients includes:

1) analysis and segmentation of the transport market;

2) formation of a database of potential consumers, which will be based on the analysis presented above;

3) an up-to-date package of services is developed for each group of clients, taking into account the industrial sector (food, construction, oil, etc.) and the key needs of client groups (Fig. 4);

4) taking into account the interests of potential customers, you need to create an individual offer of cooperation.

Nomenclature of the indicator groups in the field of cargo rail transportation				
Service quality indicators	Reliability index	Financial performance	Availability indicators and flexibility	Client indicators
Quality of services (standards and qualities)	Compliance (contractual) terms of delivery	Client's expenses (transport services)	Availability of services, procedure simplicity and service order	Client potential
Range of services	Transportation timeliness	Service tariffs and rates	Additional services portfolio	Client involvement
Order coordination	Safety of transported cargo	Carrier's financial stability	Distance form customer service centers	Customer turnover coefficient
Quality control	Transportation reserves availability	Supplier's financial stability	Readiness for approval of special terms of transportation	Client involvement
Staff training	High level of transport schedule compliance	Flexible pricing	Readiness for re-consignment	Client claims
Service fulfillment	High level of providing and cleaning cargo carriages from public tracks	Customer bonus scheme	Access to information systems and EDM systems	

Fig. 3. Nomenclature of groups of indicators of the quality of transport services in the field of cargo transportation by rail

Client	Requirements for the quality of transport services		
	Large volume	Average volume	Average volume
Container operator and freight forwarder	Rhythm. processability, dispatch "from the departure station to the destination station"	Specific knowledge, individual approach, reliability and safety	Special knowledge, individual approach, reliability and safety
Roadconstruction company			
A logistics company working on infrastructure projects	Individual approach, door-to-door delivery, adaptability	"Door-to-door" delivery, "just in time"	
A company in the oil, gas or metallurgical industry	Rhythm. processability, delivery "from the departure station to the destination station"	–	Door-to-door delivery, "just in time"
Retailer	Knowledge of specifics, individual approach, "just in time", reliability and safety	Knowledge of specifics, individual approach, "door-to-door", "just in time"	–
One-timeclient	–	–	Knowledge of specifics, individual approach, "door-to-door", "just in time"

Fig. 4. Examples of key needs of client groups

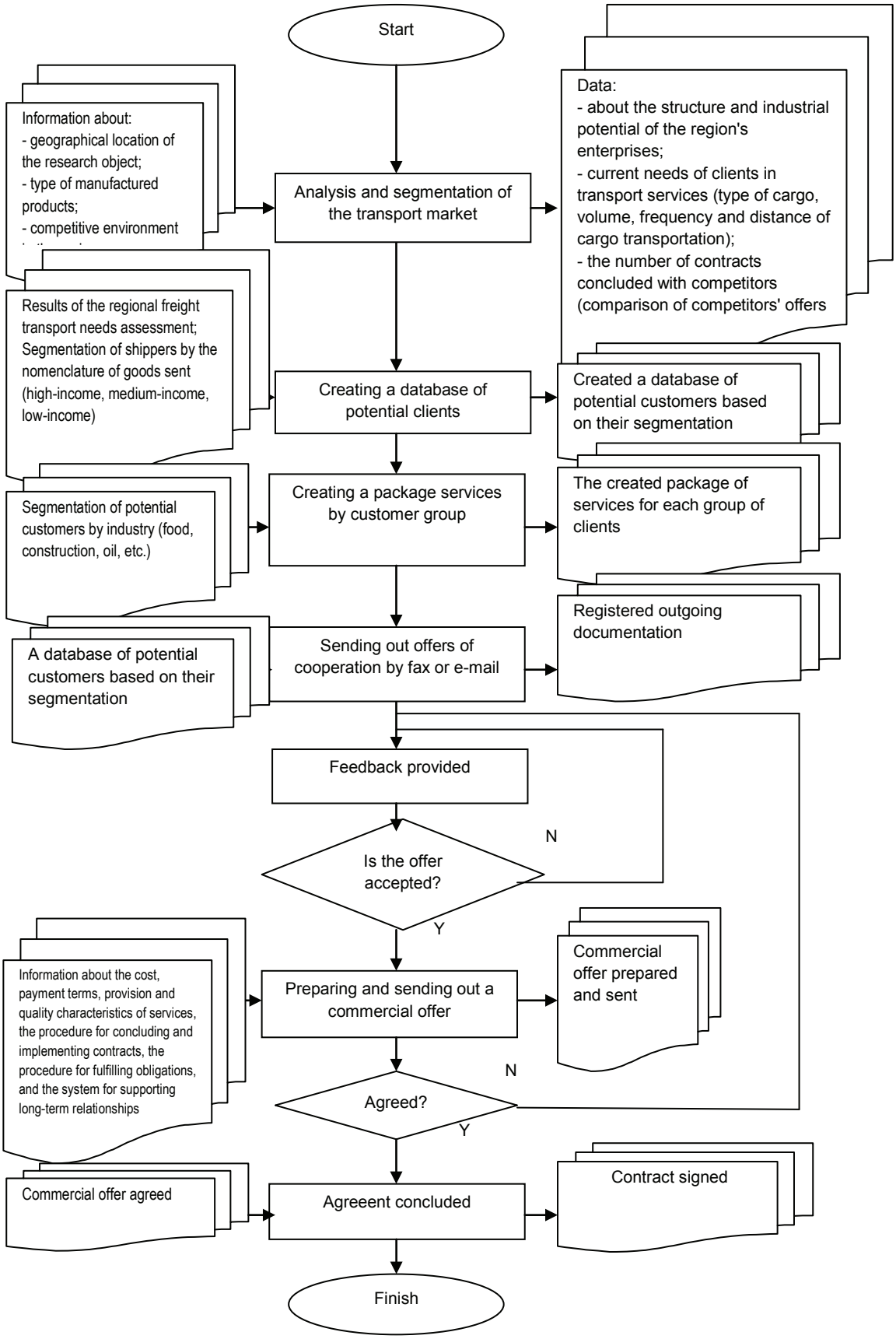

Fig. 5. Algorithm for working with potential clients in the field of cargo transportation

Having received positive feedback from a potential client and agreeing to the terms of the company, the next step is to prepare and send out a commercial offer [17].

Improving the competitiveness of rail transport can include the following steps:

– increase the speed of approval of requests for cargo transportation, minimize logistics control in places where there are no limiting infrastructure sections, reduce the list of documents required to conclude a contract for services related to the transportation of goods by rail;

– prompt decision-making on changing the tariff for competing types of cargo and transportation directions, taking into account seasonality;

– prompt decision-making on changing tariff conditions, if we are talking about opening new enterprises that create an additional cargo base for Russian.

Customer satisfaction assessment is the main element of the quality management system. It not only allows for quality control of service delivery, provides a basis for analysis and management decision-making, but also provides feedback necessary for any sustainable and capable of development system [9; 10].

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Формирование подхода привлечения клиентов в сфере грузоперевозочного процесса на железнодорожном транспорте

С.В. Иванова, Е.Д. Молчанова, М.М. Полынская

ФГБОУ ВО «Иркутский государственный университет путей сообщения», г. Иркутск (Россия)

Ключевые слова и фразы: железнодорожный транспорт; клиентоориентированность; конкурентоспособность; оценка удовлетворенности потребителей; потенциальный клиент.

Аннотация. Цель исследования состоит в рассмотрении работы железнодорожных предприятий, связанных с грузоперевозками, где всегда присутствуют оценочные показатели качества деятельности. Задачей исследования является анализ существующей системы оценки деятельности предприятий по параметрам качества, по результатам которого предложены критерии оценки, предусматривающие превентивные мероприятия при предоставлении услуг. В статье также приведены результаты анализа работы по взаимодействию грузоотправителей и организаций-перевозчиков. В работе использованы общенаучные методы. В результате спроектирован и представлен алгоритм по работе с потенциальными грузоотправителями, который предусматривает формирование базы данных по региону среди грузоотправителей, анализ траекторий передвижения грузов и определение требуемых параметров к перевозочному процессу железнодорожным транспортом. На основании проведенных исследований и представленных результатов сформирован проект стандарта организации по предложенной проектной модели, которую можно применять на любых предприятиях-грузоперевозчиках в сфере железнодорожного транспорта.

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List of Authors

Karim Hassan H.K. – Master's Student, N.P. Ogaryov Mordovia State University, Saransk (Russia), E-mail: aligghassan2@gmail.com

Карим Хасан Х.К. – магистрант Мордовского государственного университета имени Н.П. Огарева, г. Саранск (Россия), E-mail: aligghassan2@gmail.com

Korotin P.S. – Master's Student, N.P. Ogaryov Mordovia State University, Saransk (Russia), E-mail: pasha.korotin@yandex.ru

Коротин П.С. – магистрант Мордовского государственного университета имени Н.П. Огарева, г. Саранск (Россия), E-mail: pasha.korotin@yandex.ru

Kulikov O.A. – Master's Student, N.P. Ogaryov Mordovia State University, Saransk (Russia), E-mail: jleg03@yandex.ru

Куликов О.А. – магистрант Мордовского государственного университета имени Н.П. Огарева, г. Саранск (Россия), E-mail: jleg03@yandex.ru

Alekseev E.G. – Candidate of Technical Sciences, Associate Professor, Department of Information Security and Service, N.P. Ogaryov Mordovia State University, Saransk (Russia), E-mail: profyal@mail.ru

Алексеев Е.Г. – кандидат технических наук, доцент кафедры информационной безопасности и сервиса Мордовского государственного университета имени Н.П. Огарева, г. Саранск (Россия), E-mail: profyal@mail.ru

Tregubov A.S. – Postgraduate Student, Novosibirsk National Research State University, Novosibirsk (Russia), E-mail: Artem.tregubov@mail.ru

Трегубов А.С. – аспирант Новосибирского национального исследовательского государственного университета, г. Новосибирск (Россия), E-mail: Artem.tregubov@mail.ru

Malyugina O.V. – Postgraduate Student, Novosibirsk National Research State University, Novosibirsk (Russia), E-mail: Artem.tregubov@mail.ru

Малюгина О.В. – аспирант Новосибирского национального исследовательского государственного университета, г. Новосибирск (Россия), E-mail: Artem.tregubov@mail.ru

Abramov I.L. – Candidate of Technical Sciences, Associate Professor, Department of Technology and Organization of Construction Production, National Research Moscow State University of Civil Engineering, Moscow (Russia); E-mail: ivan2193@yandex.ru

Абрамов И.Л. – кандидат технических наук, доцент кафедры технологий и организации строительного производства Национального исследовательского Московского государственного строительного университета, г. Москва (Россия), E-mail: ivan2193@yandex.ru

Al-Zaidi Z.A. – Postgraduate Student, National Research Moscow State University of Civil Engineering, Moscow (Russia); E-mail: zaidalzaidi20142016@gmail.com

Аль-Заиди З.А. – аспирант Национального исследовательского Московского государственного строительного университета, г. Москва (Россия), E-mail: zaidalzaidi20142016@gmail.com

Yamshanov I.V. – PhD in Architecture, Associate Professor, Higher School of Hydrotechnical and Power Engineering, Institute of Civil Engineering, Peter the Great St. Petersburg Polytechnic University, St. Petersburg (Russia), E-mail: dartigor@mail.ru

Ямшанов И.В. – кандидат архитектуры, доцент Высшей Школы гидротехнического и энергетического строительства Инженерно-строительного института Санкт-Петербургского политехнического университета Петра Великого, г. Санкт-Петербург (Россия), E-mail: dartigor@mail.ru

Ablyazov T.H. – Candidate of Economic Sciences, Associate Professor, Department of Construction Economics and Housing and Public Utilities, St. Petersburg State University of Architecture and Civil Engineering, St. Petersburg (Russia), E-mail: 3234969@mail.ru

Аблязов Т.Х. – кандидат экономических наук, доцент кафедры экономики строительства и ЖКХ Санкт-Петербургского государственного архитектурно-строительного университета, г. Санкт-Петербург (Россия), E-mail: 3234969@mail.ru

Busarov S.S. – Candidate of Technical Sciences, Associate Professor, Department of Refrigeration and Compressor Equipment and Technology, Omsk State Technical University, Omsk (Russia), E-mail: bssi1980@mail.ru

Бусаров С.С. – кандидат технических наук, доцент кафедры холодильной и компрессорной техники и технологии Омского государственного технического университета, г. Омск (Россия), E-mail: bssi1980@mail.ru

Busarov I.S. – Lecturer, Department of Refrigeration and Compressor Equipment and Technology, Omsk State Technical University, Omsk (Russia), E-mail: habr86@mail.ru

Бусаров И.С. – ассистент кафедры холодильной и компрессорной техники и технологии Омского государственного технического университета, г. Омск (Россия), E-mail: habr86@mail.ru

Kobylskiy R.E. – Master's Student, Omsk State Technical University, Omsk (Russia), E-mail: roman.kobilsky@gmail.com

Кобыльский Р.Э. – магистрант Омского государственного технического университета, г. Омск (Россия), E-mail: roman.kobilsky@gmail.com

Sinitsyn N.G. – Master's Student, Omsk State Technical University, Omsk (Russia), E-mail: roman.sinitchin@gmail.com

Синицын Н.Г. – магистрант Омского государственного технического университета, г. Омск (Россия), E-mail: roman.sinitchin@gmail.com

Ivanova S.V. – Senior Lecturer, Department of Quality Management and Engineering Graphics, Irkutsk State Transport University, Irkutsk (Russia), E-mail: sofya-ivanova-1988@mail.ru

Иванова С.В. – старший преподаватель кафедры управления качеством и инженерной графики Иркутского государственного университета путей сообщения, г. Иркутск (Россия), E-mail: sofya-ivanova-1988@mail.ru

Molchanova E.D. – Candidate of Technical Sciences, Associate Professor, Head of Department of Quality Management and Engineering Graphics, Irkutsk State Transport University, Irkutsk (Russia), E-mail: elenam467@mail.ru

Молчанова Е.Д. – кандидат технических наук, доцент, заведующий кафедрой управления качеством и инженерной графики Иркутского государственного университета путей сообщения, г. Иркутск (Россия), E-mail: elenam467@mail.ru

Polynskaya M.M. – Candidate of Economic Sciences, Associate Professor, Department of Quality Management and Engineering Graphics, Irkutsk State Transport University, Irkutsk (Russia), E-mail: marypo1976@yandex.ru

Полынская М.М. – кандидат экономических наук, доцент кафедры управления качеством и инженерной графики Иркутского государственного университета путей сообщения, г. Иркутск (Россия), E-mail: marypo1976@yandex.ru

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