





# Application of Professional Risk Management Methods in the Occupational Safety and Health Management System at an Oil and Gas Production Enterprise

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**Abstract:** Personal characteristics of employees play a significant role in shaping their behavior in the workplace. However, certain personality traits can also become risk factors that contribute to dangerous situations in the workplace. The purpose of this study is to develop and test a method for assessing the risk behavior of personnel in order to create safe working conditions and prevent occupational risks. Risk behavior refers to the behavior of employees at the workplace who are prone to violating occupational safety and health requirements. The paper presents the results of a study of the assessment of such behavior among employees of an oil and gas enterprise using an ipsative questionnaire. The study included an analysis of the methods used at the enterprise to manage occupational risks, a questionnaire for employees on their commitment to safe work, and a calculation of the dynamics of injuries at the enterprise. Detailed research was conducted, and the results were supported by illustrations and tables, which adds scientific credibility and clarity to the work. Methods for applying the research results at the enterprise were proposed.

## 1 INTRODUCTION

The oil and gas industry plays an important role in the economy of any country, providing energy security and generating significant revenues. However, the high level of occupational risks associated with the extraction and processing of hydrocarbons requires special attention to occupational health and safety. Managing occupational risks within the framework of occupational health and safety management becomes not only an urgent task, but also a necessity to ensure the safety and health of workers, as well as the sustainability of production.

Today, managing occupational risks on a systematic basis is not just a way to reduce injuries and occupational diseases, but a mandatory requirement for any valid occupational safety and health system (Lomachenko, 2020; Andrunyak, Kolot, Ledyeva, 2025).

## 2 THE SUBJECT OF THE STUDY

The oil and gas industry is characterized by a high degree of production risk. The main determinants of increased danger are (Mishchikhin, 2021):

- territorial remoteness of production facilities;
- unfavorable climatic parameters of the extraction regions;
- use of high-tech equipment;
- handling of flammable chemical compounds;
- implementation of technological processes under conditions of increased pressure.

The concept of risk conceptually combines two components: the probability of an event occurring and the scale of its potential consequences. In turn, occupational risk is characterized as the probability of

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a dangerous event occurring during the performance of work in all functional areas.

In the context of the oil and gas industry, employers are responsible for ensuring safe working conditions and protecting the health of their employees. This responsibility is crucial, as safety and health measures are key factors in determining the sustainability and growth potential of an organization.

Ensuring the safety of workers from occupational injuries requires the mandatory use of personal protective equipment (PPE). The regulations for issuing these funds are issued in accordance with Order No. 767n of the Ministry of Health and Social Development of the Russian Federation dated October 29, 2021. The operation of oil and gas industry facilities must comply with the safety regulations developed by the Federal Service for Environmental, Technological, and Nuclear Supervision.

The implementation of a risk-based approach (Hosseinnia Davatgar, Paltrinieri, Bubbico, 2021) contributes to the internalization by employees of the need to regularly assess potential risks in two key modes of work: during ongoing operational activities and when performing work under the authorization system. Thus, risk management is a triad of interrelated processes: monitoring (control), analysis (evaluation), and minimization (reduction) of risks.

Therefore, the subject of research in the process of risk management in the field of occupational safety is the assessment of the risk behavior of employees at the enterprise.

## 2.1 The risk management process using the example of other enterprises

Risk management planning and implementation is the relationship between preventive and reactive risk management measures and industrial safety, occupational health, and environmental protection.

For example, Gazprom-Neft PJSC pays special attention to employee health: the company has implemented a corporate health and disease prevention system. The key principle of the system is a risk-oriented approach, which allows for effective management of occupational and professional risks.

As part of the improvement of the company's management system, measures have been developed and tested to reduce the likelihood of accidents or minimize their consequences, known as effective barriers. A corporate-wide program has been implemented "Safety Frame" (Figure 1).

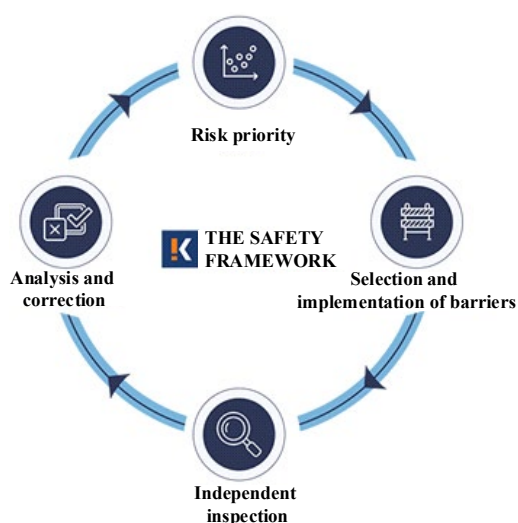


Figure 1: The company's corporate security program, "Security Framework".

The occupational risk management strategy prioritizes providing industrial facilities with modern medical infrastructure. The required equipment for medical facilities includes: stable communication, diagnostic and rescue equipment, medical transport, and telemedicine solutions to enable doctors to quickly consult with specialists.

Since 2006, Rosneft has been successfully implemented and operates "Integrated Management System for Industrial Safety, Occupational Health and Environmental Protection" (IMS IPOHPE). This system is an integral part of the company's overall management system and is presented in Figure 2.

As in the above-mentioned enterprises, PJSC NK RUSSNeft applies an Integrated Management System based on the principles of a risk-oriented approach. The system is integrated into all areas of the company's activities and production processes.

The Lukoil Group operates a corporate Integrated Management System (IMS) that covers industrial, fire, and radiation safety, emergency prevention and response, occupational health, and environmental protection. The development of IMS has been carried out on a voluntary basis since the mid-1990s. At the same time, the system is being developed in accordance with the requirements of current Russian legislation, as well as in accordance with the best domestic and international practices. The scope of the IMS is based on an analysis of internal and external factors that can affect the company's strategic goals. The system includes annual procedures for identifying risks, environmental aspects, and

implementing measures to manage identified risks and environmental aspects.

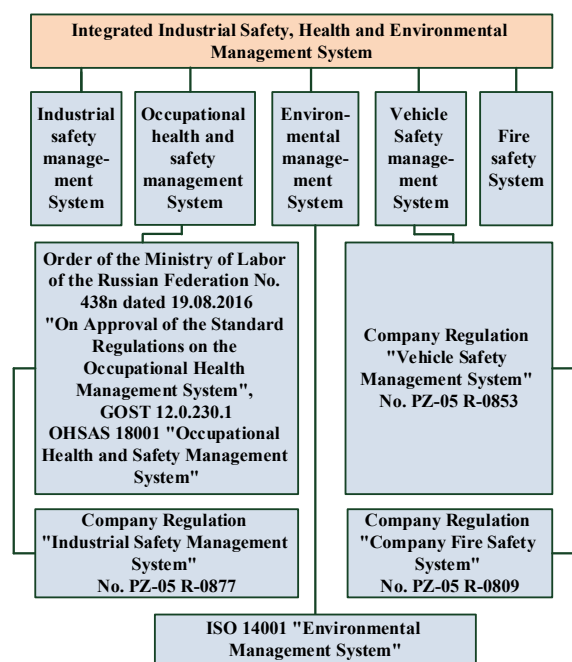


Figure 2: Integrated PBOTOS Management System in PJSC Rosneft.

A risk-oriented approach allows for systematic work: planning, developing, and implementing targeted functional programs that are approved by the Board of LUKOIL PJSC. These programs are calculated for three years and are updated annually.

## 2.2 Analysis of injury dynamics at the enterprise

The activities of an oil and gas production enterprise are very extensive and are supported by a large number of different facilities. Some facilities are being built, some are being repaired or reconstructed, and some are being dismantled, which means that the enterprise has a large volume of construction, installation, and dismantling work. High-rise work is an integral part of such work.

In the period from 2020 to April 2024, only 19 accidents were recorded at the oil and gas producing enterprise (Ivanov, 2022), the average number of which is 9464 people, including 2 fatal cases. A detailed diagram of the causes of industrial accidents by type(s) of injury is shown in Figure 3.

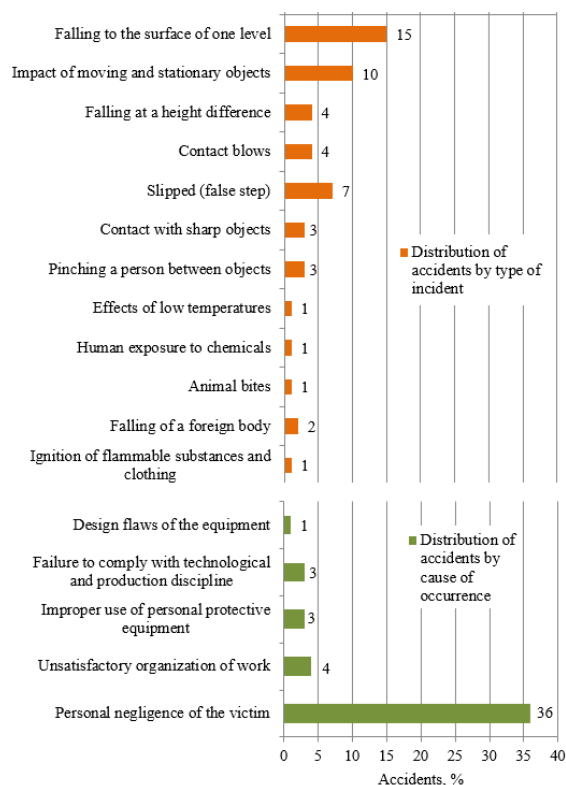


Figure 3: Distribution of accidents by type of incident and by cause of incident, %.

## 2.3 Calculation of injury rates

In the Russian Federation, the main indicators of occupational injuries include (Pankov, Kuleshova, 2021):

- the injury frequency rate is a measure that expresses the number of work-related accidents per 1,000 employees;

- the severity of injury rate is a measure that determines the number of days of disability per accident;

- the frequency of fatal injuries rate is a measure that determines the number of fatal injuries.

Abroad (USA and EU), the most common statistical indicators are:

- the LTIF (Lost Time Injury Frequency) indicator – the number of injured workers (including fatal injuries) per 1 million of worked hours;

- the LWIF (Lost Work Day Injury Frequency) indicator is the number of injured workers (excluding fatal injuries) per 1 million worked hours;

- the FAR (Fatal Accident Rate) indicator is the number of fatal injuries per 100 million worked hours;

- T 1-2 (Transparency 1-2) – the ratio of the number of occupational injuries with loss of ability to work to the number of fatal occupational injuries;
- T 1-3 (Transparency 1-3) – the ratio of the total number of registered occupational injuries to the number of fatal occupational injuries;
- TRIR – the indicator of the registered cases of injury per 1 million of the worked-out man-hours;
- the coefficient of occupational diseases per 1 million of the worked-out man-hours;
- the coefficient of lost days (days missed due to an accident and/or occupational disease) per 1 million of the worked-out man-hours.

The calculations of the indicators are presented in Table 1. For clarity, the results of the calculations of the general coefficients are presented in Figure 4. From both calculations, it is noticeable that the overall indicators of the frequency of injuries decrease over the years. However, in 2022, there is a sharp increase in the indicators, as fatal accidents were recorded this year.

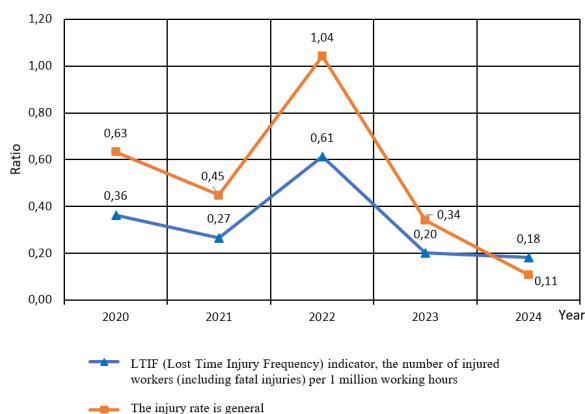


Figure 4: LWIF (Lost Work Day Injury Frequency) and Injury Frequency Ratio.

Analysis of statistical data and calculations of the frequency of injuries have shown that as technology improves, its reliability and safety increase, and professional competence increases, the level of injuries decreases. When examining the statistical data on injuries, it is evident that the same types of occupational risks persist over time.

The causes of such accidents are circumstances in which an employee is forced to perform dangerous actions that lead to injuries and accidents. Violations of safety requirements are the result of circumstances created by management personnel at all levels of the enterprise, which involve allowing employees to participate in processes and operations where they are likely to violate safety requirements.

Table 1: Calculation of injury rates used in the Russian Federation and worldwide.

Indicator	2020	2021	2022	2023	2024
<i>Calculation of injury rates used in the Russian Federation</i>					
Fatal injury rate	0,00	0,00	0,30	0,00	0,00
Injury severity coefficient	75,80	48,70	151,0	125,3	41,00
Injury frequency rate excluding fatalities	0,63	0,45	0,78	0,34	0,11
Injury rate coefficient (total)	0,63	0,45	1,04	0,34	0,11
<i>Calculation of injury rates used worldwide</i>					
Injury rate indicator LWIF (Lost Work Day Injury Frequency)	0,36	0,27	0,61	0,20	0,18
Injury rate indicator LWIF (Lost Work Day Injury Frequency)	0,36	0,27	0,46	0,20	0,18
Fatal injury rate FAR (Fatal Accident Rate)	0,00	0,00	153,35	0,00	0,00
T 1-2 (Transparency 1-2)	4,00	3,00	4,00	3,00	1,00
T 1-3 (Transparency 1-3)	11,00	6,00	3,67	12,00	2,00
TRIR	0,64	0,27	0,38	0,60	0,18
Occupational disease rate	0,00	0,00	0,00	0,00	0,00
The coefficient of lost days	27,60	13,00	69,47	25,26	7,44

Personal factors in the workplace, such as risky behavior, are also causes of injuries and accidents. These factors lead to dangerous intentional or unintentional actions, and employee actions are the primary cause of accidents.

### 3 THE RESULTS OF THE STUDY

Safety culture in the workplace plays a crucial role in ensuring the well-being of employees and the efficiency of production processes. It encompasses the values, beliefs, principles, and behaviors that contribute to a safe working environment. Unsafe behavior in the workplace can have severe consequences for both employees and organizations. With a focus on creating a safety culture at the enterprise and controlling unsafe employee behavior, a study of risky behavior was conducted using an assessment questionnaire. In order to assess employees' attitudes towards various aspects of safe work, a questionnaire was developed "Assessment of safety culture". The questions included both closed-ended and open-ended items, allowing for the collection of qualitative and quantitative data.

A total of 1,362 employees were surveyed, including 52% of workers and 48% of managers and specialists.

The Risk Behavior Questionnaire is a tool that allows you to assess the risk behavior of employees in the workplace. It is a set of questions designed to identify the characteristics that lead to dangerous situations.

The purpose of the Risk Behavior Questionnaire is to:

- Assess employees during the recruitment process;
- Form a pool of safety leaders;
- Adapt training and development programs;
- Monitor changes.

Instrument type: ipsative questionnaire ("choice without choice", implies presenting the respondent with questions in which he has to make a forced choice between two alternatives having approximately equal loadings on the factor of social desirability) with a social desirability scale. Here, an ipsative questionnaire is understood as a forced-choice technique in which the participant is offered several options to choose the most suitable one for him. Each answer option refers to different measured qualities, while the answer options are balanced on social desirability.

Assessment scale: percentiles (100% scale). A high percentile indicates a high risk of unsafe behavior.

Assessment criteria: risk-taking, emotional instability, excessive competitiveness, and disregard for rules (instructions).

A total of 4126 results were selected for analysis. The sample was based on the employees' work

experience, gender, and age. The results of the risk behavior study are presented in Figures 5-7.

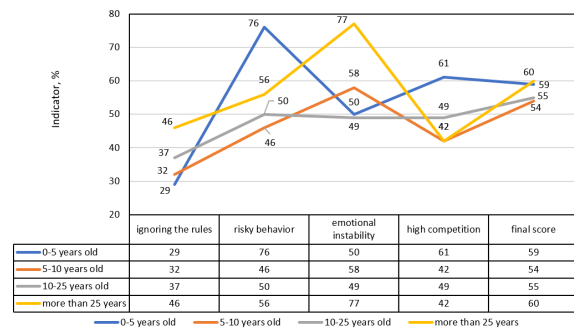


Figure 5: Differences in work experience.

*Differences by age.* Test subjects aged 20-30 are more likely to follow the rules than those aged 40-50. For those aged 50+, a calm environment that does not provoke strong emotional reactions is important.

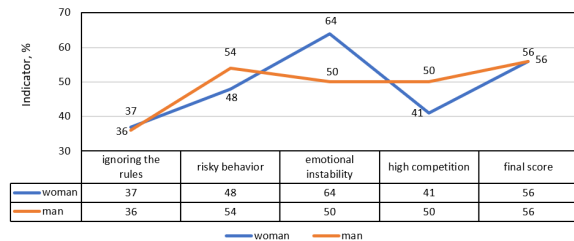


Figure 6: Gender differences among employees.

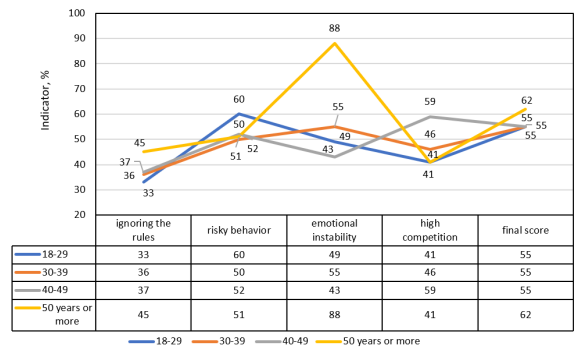


Figure 7: Age differences among employees.

*Differences by gender.* The results clearly reflect gender differences in behavior (or stereotypes): men are slightly more risk-taking and competitive than women, while being more emotionally stable. Notably, the final score is equal for both genders. This suggests that the questionnaire does not discriminate against individuals based on their gender.

*Differences by age.* Test subjects aged 20-30 are more likely to follow the rules than those aged 40-50. For those aged 50+, a calm environment that does not provoke strong emotional reactions is important. Those aged 40-50 are more likely to engage in competitive behavior than other age groups.

Based on the results of an anonymous survey of employees, the main shortcomings in the field of safe work can be noted:

- some employees are not committed to complying with occupational safety requirements;
- there have been cases of disregard for occupational safety, where work is carried out in violation of safety requirements, either on a personal initiative or at the behest or coercion of management;
  - concealing information about incidents;
  - performing work with safety locks disabled;
  - managers and workers are allowed to operate the equipment in excess of the operating parameters and the allowed service life.;
  - performing work with faulty tools and fixtures;
- there are people from specialists and working staff at the enterprise who neglect the use of PPE;
- lack of awareness among employees about the possibility of each employee influencing the suspension of work in the event of a potential incident.

The survey results are analyzed and classified according to the risk level: low, medium, and high. These results are then displayed on a graph or map, where each area corresponds to a specific risk level.

Based on the results of the ipsative questionnaire, it is possible to identify groups of employees who are prone to risky behavior and take appropriate measures. The formation of work shifts includes the distribution of employees according to their work schedule, taking into account their skills and competencies, as well as assessing their risk behavior. Using the information obtained from the questionnaire, it is possible to decide on the participation or exclusion of specific employees from certain shifts or work groups. An example of the formation of shifts is presented in Figure 8. By allocating a unit or shift, you can compensate for the risks in that unit by rotating its members.

Another way to use the research results is to create risk heat maps. This technique allows you to graphically represent the results of assessing employee risk behavior and identify areas where the risk is highest. An example of a risk heat map is shown in Figure 9.

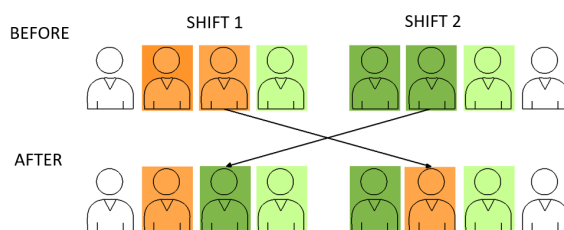


Figure 8: Formation of shifts.

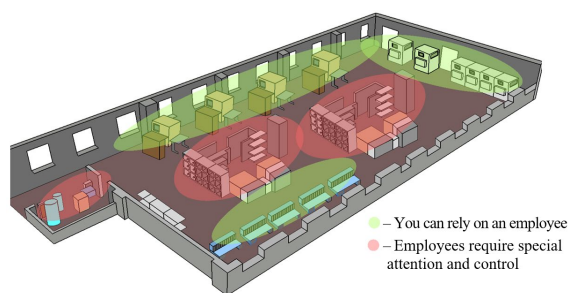


Figure 9: Heat map of risk.

## 4 CONCLUSIONS

Personal characteristics of employees play a significant role in shaping their behavior in the workplace. Individual preferences, personality traits, and levels of stress tolerance can influence an individual's ability to adapt to changing work environments. However, certain personality traits can also pose risks that contribute to hazardous situations in the workplace.

Research on the personality factor in the workplace allows us to understand which personality traits may be associated with risky behavior. The most commonly studied personality traits in this area include risk tolerance, sense of responsibility, self-control, and anxiety. Additionally, the personality factor may also include aspects such as motivation, values, and moral attitudes. All of these factors can influence the decision-making process in the workplace.

Risky behavior of employees in the workplace is one of the important issues faced by many companies. Regardless of the industry or type of activity, there is always a risk of an accident or occupational disease.

The Ipsative employee questionnaire revealed that risky behavior in the workplace can have serious consequences for both employees and the

organization. Specifically, the damage, injuries, or even death that may occur as a result of risky behavior have a significant impact on the health and well-being of employees. Severe injuries can lead to temporary or permanent disability, and in some cases, they can result in permanent disability. Additionally, work-related accidents can have a psychological impact on employees, who may suffer from post-traumatic stress disorder or other mental health issues.

Thus, firstly, it is proposed to combine the formation of work shifts based not only on the results of the questionnaire, but also on the assessment of employees' professionalism and experience. This will allow for the focus of efforts to ensure the safety of employees, the rational distribution of the supervisor's control between areas with different employees' propensity for unsafe behavior. Taking into account risk behavior when forming work shifts allows for a more flexible approach to the problem and reduces the likelihood of unforeseen situations at work.

Secondly, the combination of a heat map and risk zoning can also help identify urgent measures for reshaping shifts and so on. Thus, a risk heat map provides a visual representation of where the highest risks are in the workplace and where efforts should be focused to improve safety.

## REFERENCES

- Lomachenko, T., 2020. Risk management strategy for the oil and gas complex enterprise. *Bulletin of the Altai Academy of Economics and Law*. № 12 (part 1), pp. 133-137.
- Andrunyak, I., Kolot, V., Ledyeva, O., 2025. Assessment of professional risk levels for welding shop personnel using the example of a river port. *Bulletin of the Scientific Center for Life Safety*. № 2 (64), pp. 64-75.
- Mishchikhin, R., 2021. Risk management in the activities of oil and gas companies. *Young scientist*. № 25 (367), pp. 216-218.
- Providing employees with individual and on-call PPE: [electronic resource]. URL: [https://www.kontur-extern.ru/info/45216-obespechenie\\_rabotnikov\\_siz](https://www.kontur-extern.ru/info/45216-obespechenie_rabotnikov_siz) (accessed: 15.10.2025).
- Hosseinnia Davatgar, B., Paltrinieri, N., Bubbico, R., 2021. Safety Barrier Management: Risk-Based Approach for the Oil and Gas Sector. *Journal of Marine Science and Engineering (JMSE)*. 9(7):722.
- Gazprom Neft Public Joint Stock Company: [electronic resource]. URL: <https://www.gazprom-neft.ru/> (accessed: 25.10.2025).
- Rosneft Public Joint Stock Company: [electronic resource]. URL : <https://www.rosneft.ru/> (accessed: 25.10.2025).
- Lukoil Limited Liability Company: [electronic resource]. URL: <https://lukoil.ru/> (accessed: 25.10.2025).
- Ivanov S.M., 2022. Industrial Accidents in the Arctic Oil and Gas Sector: Regional Features. *Occupational safety in industry*. № 5, pp. 28-34.
- Annual reports on the activities of the Federal Service for Environmental, Technological, and Nuclear Supervision (Rostekhnadzor). Analytical reports on the state of industrial safety and occupational health for 2020–2024: [internal open reports]. URL: [https://www.gosnadzor.ru/public/annual\\_reports/](https://www.gosnadzor.ru/public/annual_reports/) (accessed: 25.10.2025).
- Pankov, V., Kuleshova, M., 2021. Analysis of the risk of industrial injuries in the main industries. *Health risk analysis*. № 4, pp. 119-126.