OCCUPATIONAL RISK AND ANALYSIS OF ITS LEVELS

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Abstract. This article analyzes the processes of identifying, assessing, and managing hazards in production environments based on a 20-level occupational risk model. The model integrates probability and impact factors, allowing risks to be classified into 20 precise levels. The study demonstrates the effectiveness of color-coded classification (green, yellow, orange, and red zones) in enabling rapid risk evaluation and prioritization. The results indicate that the model improves safety management processes, reduces workplace accidents, and ensures more efficient resource allocation. Furthermore, future development directions include the automation of the model and the integration of artificial intelligence technologies for advanced risk prediction.

Keywords. Occupational risk, risk assessment, 20-level model, safety management, industrial safety, hazard analysis, color-coded matrix, workplace accidents.

Introduction.

Occupational risk is defined as a system for assessing the probability and intensity of hazards and damages that may arise during work activities or industrial processes. Workplace risk factors, including technical failures, human factors, working with chemical substances, working at heights, and other hazardous conditions, can significantly affect the health and safety of employees. The main objective of occupational risk assessment is to identify hazards, evaluate them, and develop effective preventive measures to ensure workplace safety.

With the increasing complexity of modern industrial and technological processes, the number and diversity of risk factors are also growing. Therefore, there is a need to classify risks into several levels and describe them accurately. Traditional safety systems are insufficient to address such complexity, which necessitates the development of scientifically grounded and detailed risk assessment models. Occupational risk assessment is important not only for employee safety but also for ensuring production stability, efficient resource allocation, and the prevention of emergency situations.

Main Part.

In recent years, the 20-level risk assessment model has been widely applied in industrial safety studies. This model enables a more detailed and systematic classification of risks. For each hazard, the probability and impact are evaluated, and their combination results in a risk score ranging from 1 to 20. This approach not only determines the level of risk but also reflects its potential impact on workers and society.

The main advantage of this model is that it provides a clear representation of each risk factor and supports effective safety management in complex industrial environments. For example, at low-risk levels, basic protective measures are sufficient, while medium and high-risk levels require specialized training, personal protective equipment, and continuous monitoring. At extreme levels, the highest safety standards, emergency plans, and strict protocols must be implemented.

Relevance of the Study. The 20-level risk model ensures several important aspects in both research and industrial practice:

- Accurate risk assessment – clearly determines the severity of each hazard.
- Efficient resource allocation – allows more focus on high-risk operations.
- Reduction of emergency situations – helps identify necessary preventive measures at extreme risk levels.
- Employee training – supports the development of specialized training and protective measures for hazardous tasks.

Furthermore, this model can be applied across various industries such as oil and gas, chemical production, construction, and energy sectors. The results of the study provide a scientific basis for effective risk management, improving employee safety, and ensuring the stability of industrial processes.

Methods. The main objective of the study is to assess workplace hazards and risks using a 20-level model and to determine its effectiveness. For this purpose, a number of methodological approaches were applied. In the first stage, hazard identification was carried out. All risk factors in the production or work process, including technical failures, human factors, working at heights, working with chemical substances, and physical factors such as noise and vibration, were listed. At this stage, the opinions of experts and experienced workers were collected, and existing occupational safety documents and standards were also analyzed.

In the second stage, the probability and impact of each hazard were determined. Probability was assessed on a scale from 1 to 5, where 1 indicates almost no likelihood and 5 indicates a very high likelihood. The impact level was assessed from 1 to 4, where 1 represents minor injury or damage and 4 represents very serious injury or risk of death. Through this combination, risks were classified in a more detailed manner.

In the third stage, the 20-level risk score was calculated. For each hazard, the combination of probability and impact was multiplied, and the risk level was determined on a scale from 1 to 20. In this way, the impact of each risk on workers and society, as well as its likelihood, was clearly demonstrated.

The fourth stage was visualization. Risk levels were represented using a colored 3D matrix or diagram. The levels were arranged along the x-axis, probability along the y-axis, and impact along the z-axis. Colors were used to indicate risk levels: green – low, yellow – medium, orange – high, and red – extreme. This visualization enables employees and management to quickly and clearly assess risks.

Additionally, within the methodology, measures for risk reduction were developed. While standard protective equipment is sufficient for low and medium risk levels, high and extreme levels require specialized training, personal protective equipment, and emergency plans. The study showed that the 20-level risk model provides a scientific basis for effective industrial safety management and ensuring employee safety.

Results. The results of the study showed that the 20-level occupational risk model is practically effective. When hazard factors were assessed based on probability and impact, their classification into clear levels significantly facilitated risk management. In particular, it was found that in complex production processes, it is not sufficient to evaluate risks only as “low,” “medium,” or “high.” The 20-level model made it possible to assess risks in a more detailed and differentiated manner.

Table 1. Theory of the 20-Level Risk Model

Risk Level	Color Zone	Level Description	Recommended Measures
1–2	Green	Minimal	Basic control is sufficient
3–6	Green	Low	Standard safety measures
7–9	Yellow	Medium	Additional control and training
10–12	Yellow	Medium-high	Special protective equipment
13–14	Orange	High	Continuous monitoring
15–16	Orange	Very high	Preparation of emergency plan
17–18	Red	Critical	Restrict or stop work
19–20	Red	Extreme	Completely prohibit work

According to the results, it was observed that the majority of risks fall within the 7–12 level range. This indicates that medium-level risks dominate in production processes. At the same time, it was identified that high-risk factors at levels 13–16 are mainly associated with technical failures and the human factor. The most dangerous risks, namely those at levels 17–20, were observed in situations related to working at heights, explosive materials, and hazardous technological processes.

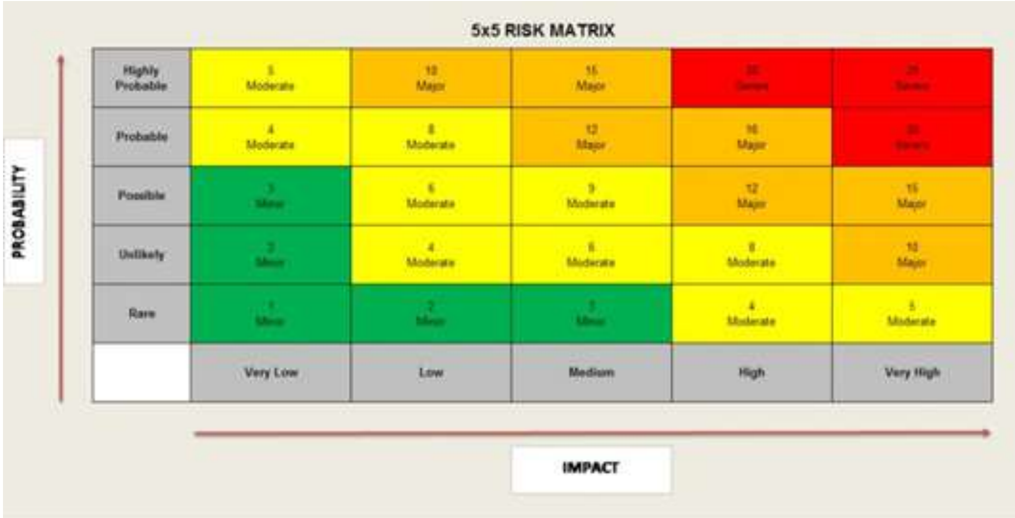

Figure 1. 5×5 Risk Matrix

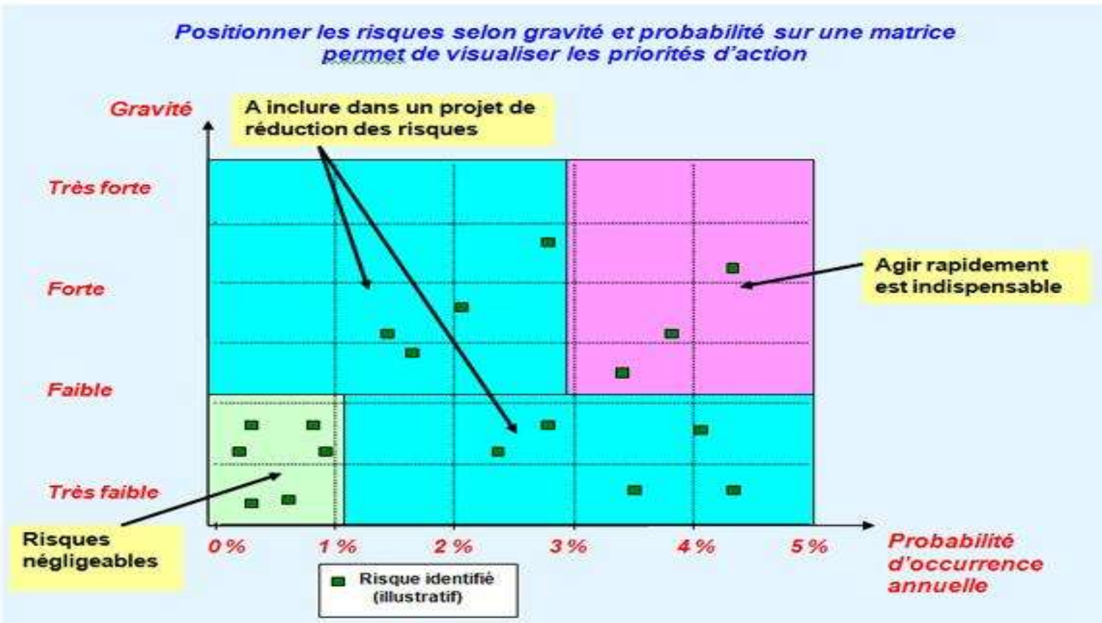

Figure 2. Risk severity levels

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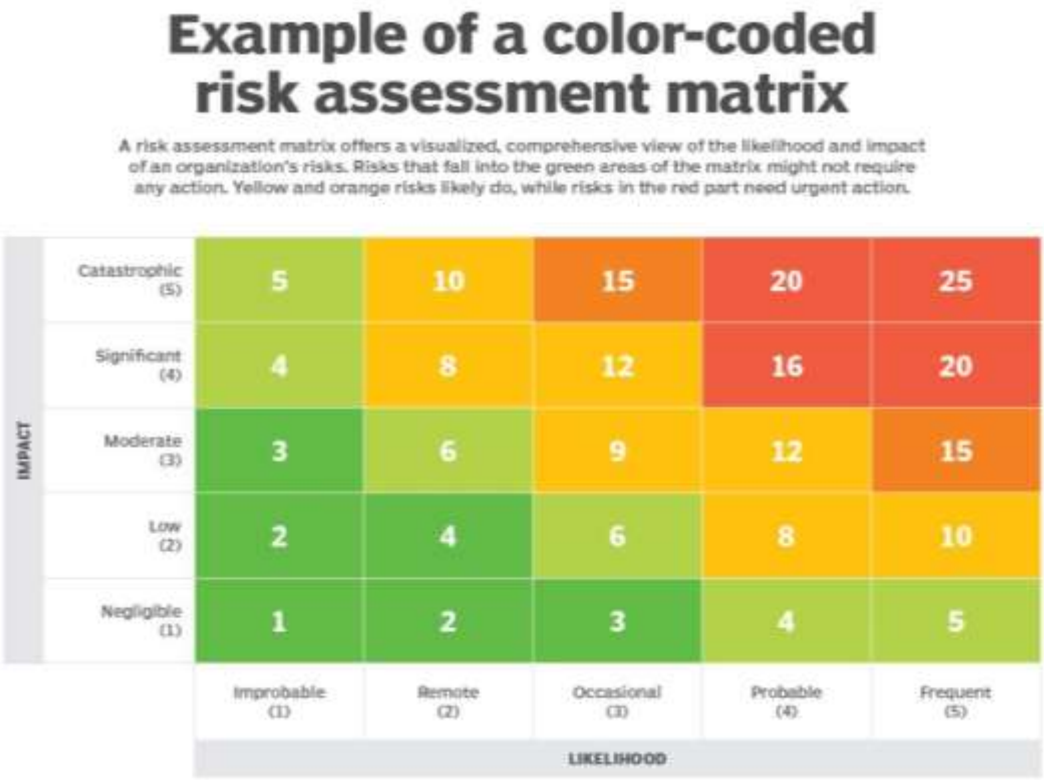

Figure 3. Color-coded matrix model for occupational risk assessment

Color classification provided a clearer representation of the results: scores from 1 to 6 were evaluated as the green zone, indicating safe conditions; 7 to 12 corresponded to the yellow zone, representing situations requiring cautionary measures; 13 to 16 were classified as the orange zone, indicating significant risk and the need for strict control; and 17 to 20 were identified as the red zone, representing extreme risk. This classification enabled management to determine risk priorities and allocate resources more effectively.

The results showed that using a 20-level model, risk levels can be clearly expressed through numerical values, which accelerates the decision-making process. In addition, the model allows monitoring the dynamics of risks over time and analyzing their changes.

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Figure 4. Industrial hazard factors: slips/falls, electric shock, and mechanical injuries

Figure 5. Main types of workplace injuries: cuts, burns, and bruises

This, in turn, contributes to improving workplace safety and reducing the number of accidents in production environments.

Discussion. Based on the obtained results, it can be stated that the 20-level occupational risk model is significantly more advanced compared to traditional assessment methods. In conventional approaches, risks are often grouped into broad categories, which may lead to some hazards being overlooked. In contrast, the 20-level model enables more precise and detailed classification of risks.

The analysis shows that the main advantage of the model is its ability to ensure greater accuracy in decision-making. For example, the difference between risk levels 10 and 12 may not be clearly distinguished in traditional systems, whereas in the 20-level model this difference is considered important and requires different safety measures. This enhances more effective safety management in production processes.

Another important feature of the model is its potential for resource optimization. Greater attention is given to high and extreme risk levels, while unnecessary allocation of resources to low-risk processes is avoided. This, in turn, improves economic efficiency.

However, there are also some limitations in applying the model. In particular, there may be a degree of subjectivity in assessing probability and impact levels. Therefore, it is essential to rely on expert judgments and accurate statistical data. In addition, implementation of the model requires staff training and an adaptation period.

Table 2. 1–20 Level Occupational Risk and Types of Hazards

Level	Risk Level	Type of Hazard (specific examples)
1	Minimal	Mild fatigue, minor discomfort
2	Minimal	Light scratches, minor cuts
3	Low	Small cuts, mild burns
4	Low	Skin damage to hands
5	Low	Mild bruising (impact injuries)
6	Low	Muscle strain
7	Moderate	Moderate cuts, bleeding
8	Moderate	Minor fracture (finger fracture)
9	Moderate	Slipping and falling
10	Moderate–High	Falling from height (low height)
11	High	Serious cuts requiring stitches
12	High	Bone fractures (arms/legs)
13	High	Electric shock (mild level)
14	High	Chemical burns
15	Very High	Falling from height (severe injury)
16	Very High	Severe fractures, internal injuries
17	Critical	Disability risk (permanent injury)
18	Critical	Severe electric shock
19	Extreme	Explosion, fire, severe burns
20	Extreme	Fatal incidents (possible death)

In general, the 20-level risk assessment model is considered an effective tool for safety management in modern industrial conditions, and it can be applied across various sectors.

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Conclusion. In conclusion, the 20-level occupational risk model is an effective tool for identifying, assessing, and managing hazards in production processes. By combining probability and impact, the model divides risks into precise levels from 1 to 20, enabling a more in-depth analysis of hazards.

The research results demonstrated the practical significance of the model. By classifying risks into color-coded zones, it allows for rapid assessment and prioritization of hazards. This contributes to improving workplace safety, reducing accidents, and protecting workers' health.

In addition, the model enables efficient allocation of resources, focuses attention on high-risk processes, and helps prevent emergency situations. This not only enhances safety but also improves economic efficiency.

In the future, further improvement of this model, its integration with automated systems, and the development of risk forecasting based on artificial intelligence will be important directions. Moreover, its broader application across various industrial sectors will further increase its universality and effectiveness.

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