

Article

“Vision Zero” Concept as a Tool for the Effective Occupational Safety Management System Formation in JSC “SUEK-Kuzbass”

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Abstract: At present, in Russia, as in many countries, the issues of reducing industrial injuries, as well as increasing the effectiveness of measures taken by employers in the field of industrial safety and introducing a culture of safe work, are widely discussed. The relevance of the topic is due to the fact that Russia is a participant in the Vision Zero campaign, founded by the International Social Security Association (ISSA) and the Institution of Occupational Safety and Health (IOSH). The article discusses the history of the emergence and development of the Vision Zero strategy from the corporate to the international level, provides the goals and objectives of the concept of “zero injuries”, studies the indicators of its implementation, and analyzes injuries at coal enterprises of the Russian Federation. As a result, a methodology for solving the tasks in the form of a list of necessary measures and target indicators of their achievement was proposed based on the example of one of the largest coal companies—JSC “SUEK-Kuzbass”. Based on the results of studies, the main conclusion has been formulated—the “Vision Zero” concept is an effective tool to promote an effective occupational safety management system.

Keywords: occupational safety; labor protection; “Vision Zero”; risk management; golden rules of Vision Zero



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1. Introduction

The industrial safety issues of coal mining enterprises and labor protection of workers are relevant all over the world [1–7]. Despite a certain downward trend in the number of industrial injuries in the Russian Federation [8–12], it is still more than zero.

The dynamics of coal mining volumes, accidents, and industrial injuries with fatal outcomes and the specific indicator of fatal injuries in 2005–2019 with an average number of workers in the coal industry of 166,450 people, according to Federal Environmental, Industrial, and Nuclear Supervision Service of Russia (Rostekhnadzor) data [13], are shown in Figure 1 and Table 1.

The measures taken by Rostekhnadzor, production control and industrial safety management systems implemented at coal industry enterprises, make it possible to reduce accidents and fatal injuries in the coal industry. Examples of this are that the specific indicator of fatal injuries, defined as the number of fatally injured miners per 1 million tons of coal mined in 2019, was 0.034 people/million tons, while the planned target is 0.11 people/one million tons, and the value of the specific indicator of fatal injuries, defined as the number of fatally injured miners per 1000 workers in the main type of activity, was 0.09 people/one thousand workers with the planned target indicator is 0.27 people/one thousand workers.

The circumstances analysis of many accidents showed that one of the main causes of injuries was shortcomings in the organization and workers’ training conduction, as a result of which there was a low personnel qualification.

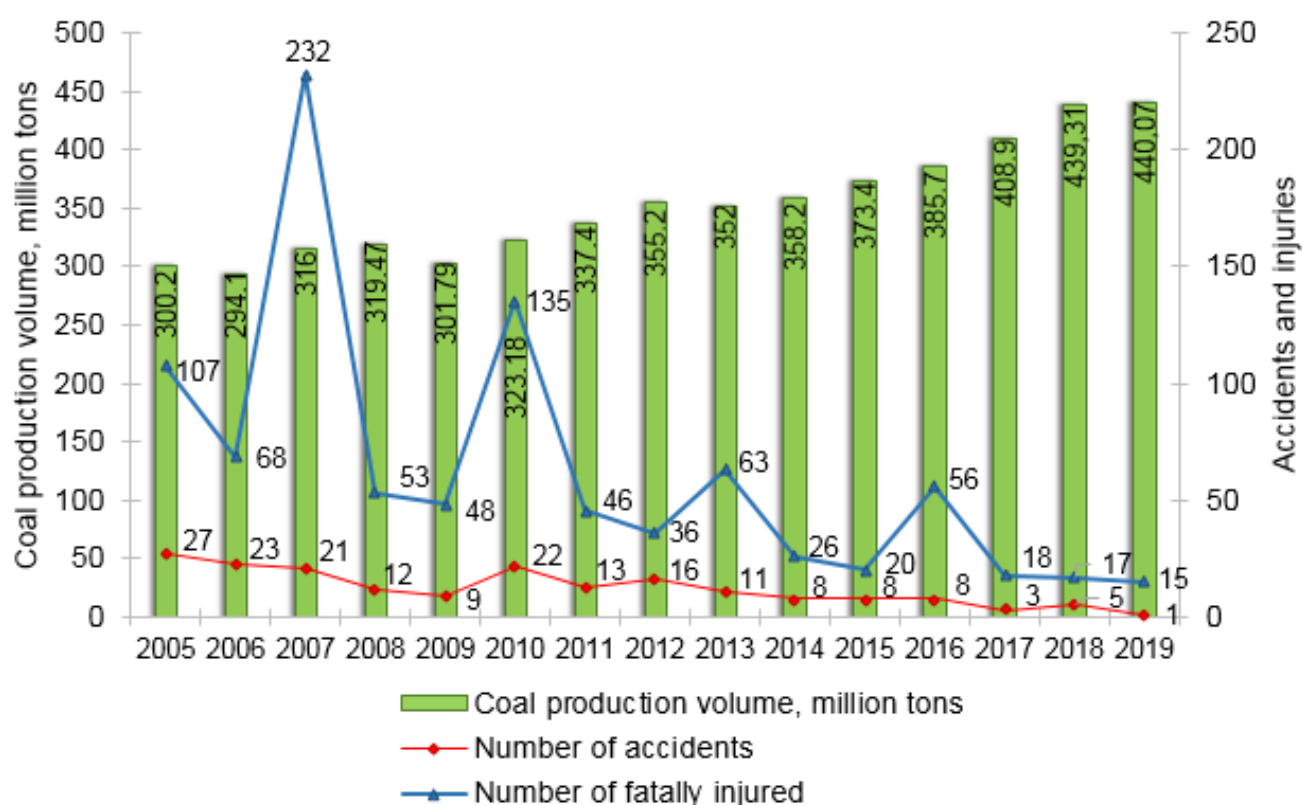


Figure 1. Dynamics of coal production volume, fatal injuries, and accidents. Source: Annual reports on the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostekhnadzor) Activities. Environmental, Industrial and Nuclear Supervision Service: http://www.gosnadzor.ru/public/annual_reports/ (accessed on 28 January 2021).

Table 1. Dynamics of the specific indicator of fatal injuries in 2005–2019.

Year	Specific Indicator of Fatal Injuries, People/Million Tons	Year	Specific Indicator of Fatal Injuries, People/Million Tons
2005	0.36	2013	0.17
2006	0.23	2014	0.07
2007	0.73	2015	0.05
2008	0.16	2016	0.14
2009	0.15	2017	0.044
2010	0.41	2018	0.039
2011	0.13	2019	0.034
2012	0.10	2020	data not available

Source: Annual reports on the Federal Environmental, Industrial and Nuclear Supervision Service of Russia (Rostekhnadzor) Activities. Environmental, Industrial and Nuclear Supervision Service: http://www.gosnadzor.ru/public/annual_reports/ (accessed on 28 January 2021).

Thus, the labor safety methods developed in the recent past at Russian enterprises, including the coal company SUEK-Kuzbass JSC, need to be improved, taking into account the available world experience.

Historically, a prerequisite for the development and implementation of the Vision Zero concept at the international level was a number of large industrial companies' desire to develop a strategy for an integrated systematic attitude to labor protection.

Currently, the concept of “zero harm”, supported by many companies, assumes that there are no harmful consequences for the health and safety of workers, their property, and the environment. However, the criterion of harm in each specific case cannot always be defined accurately enough, which forced companies to develop their own ways to

implement the concept of “zero harm”. An example is the approaches to solving the problem in various industries: oil and gas, metallurgy, and mining.

Until recently, the concept of “absolute safety” was considered the main concept on which the achievement of safety standards and guidance for companies were built around the world. For its implementation, engineering safety systems were introduced, organizational measures were improved, and a high level of technological and labor discipline was ensured. However, for a number of reasons, such as the development of industries and the emergence of fundamentally new technologies, the resources of the anthropogenic sphere have become insufficient to achieve the goal. As a result, the human community has come to understand the impossibility of creating “absolute safety” in real life. This resulted in the development of a concept of striving to achieve a level of risk that can be considered “acceptable”.

In order to influence the statistics of deaths and injuries at work, to exclude a formal approach to labor protection, the International Social Security Association (ISSA) has developed the concept of Vision Zero [14–16] or “zero injuries”, which forms a qualitatively new approach to organizing the prevention of accidents and accidents and uniting three areas at all levels of production: safety, well-being, and occupational health [17–22]

Examples of stages in the Vision Zero strategy formation at the corporate (DuPont Company, Wilmington, DE, USA) and state levels (enterprises in Japan, Germany, Sweden) are presented in the works of a number of authors (Figures A1–A4) [20,21,23–26].

In December 2017, the Ministry of Labor and Social Protection of the Russian Federation and the International Social Security Association (ISSA) signed a memorandum to promote the Vision Zero concept in Russia. To date, the movement has united about 6000 organizations. However, on the scale of Russia, where, according to official statistics, about 4.3 million enterprises and organizations are registered, this number is negligible [27–33]. The reason for this at present is that the introduction of the Vision Zero concept is not mandatory at the legislative level for Russian employers.

It is obvious that, at present in Russia, it is necessary to develop incentives at the state level for organizations that, by implementing the Vision Zero concept, prove their commitment to policies aimed at preventing and reducing the level of injuries and occupational diseases at work.

In 2012, the International Coal Section of the International Social Security Association (ISSA), the first of thirteen ISSA International Sections, decided to develop its own prevention strategy called “Vision Zero: Safety and Health in the Coal Industry Worldwide!”.

This strategy is based on the belief that, even in the coal industry, prevention measures can create conditions in which “industrial accidents are a thing of the past, and no one is killed or injured for life”. In June 2015, at a meeting of the ISSA Special Commission on Prevention Measures in South Korea, all sections unanimously decided to join the Vision Zero strategy.

In September 2017, at the World Health and Safety Congress in Singapore, ISSA announced that the Vision Zero strategy was gaining international status. At the same time, the guide for employers on the implementation of the seven Golden Rules [22] was presented.

Seven hundred employers, specialists, and experts participated in the development and testing of the guidelines. In addition, three hundred health and safety experts were preliminarily interviewed as to which simple and effective safety measures they have had positive experiences with [34–36].

At present, the Vision Zero strategy is supported by more than two thousand countries all over the world, including Denmark, Norway, Finland, Switzerland, and the United Kingdom, which have joined in recent years [37–45].

Taking into account the above, the enterprises formulated the goals and objectives of the Vision Zero concept, which are presented in Figure 2.

Goals of Vision Zero	1. Reducing and prevention of general industrial injuries. 2. Reducing and preventing fatal industrial injuries. 3. Decrease in occupational morbidity. 4. Reducing the proportion of workers employed in work with harmful and (or) hazardous working conditions.
Objectives of Vision Zero	1. Corporate labor safety culture formation, a responsible attitude to the health of employees; 2. Professional risks identification, their elimination or minimization; 3. Effectiveness of preventive measures improvement in the field of labor protection; 4. Labor protection management system Improvement; 5. Compliance of activities ensuring of labor protection with the modern level of science and technology development; 6. Level of personnel training Improving on labor protection issues; 7. Support, development and stimulation of personal and collective responsibility of employees of the organization for compliance with labor protection requirements; 8. Reducing the risks of applying penalties based on the results of inspections by the organizations exercising state supervision over the labor legislation observance.

Figure 2. Goals and objectives of the Vision Zero concept [46–49].

2. Materials and Methods

The main goal of the Vision Zero implementation at the Siberian Coal Energy Company (SUEK) is to become a leader in the global coal market not only in terms of coal production, labor productivity, efficiency, and product quality, but also in terms of production safety.

The company has defined and operates an occupational safety and health management system (OSH) during the operation of hazardous production facilities, aimed at fulfilling the strategic goal of the Company.

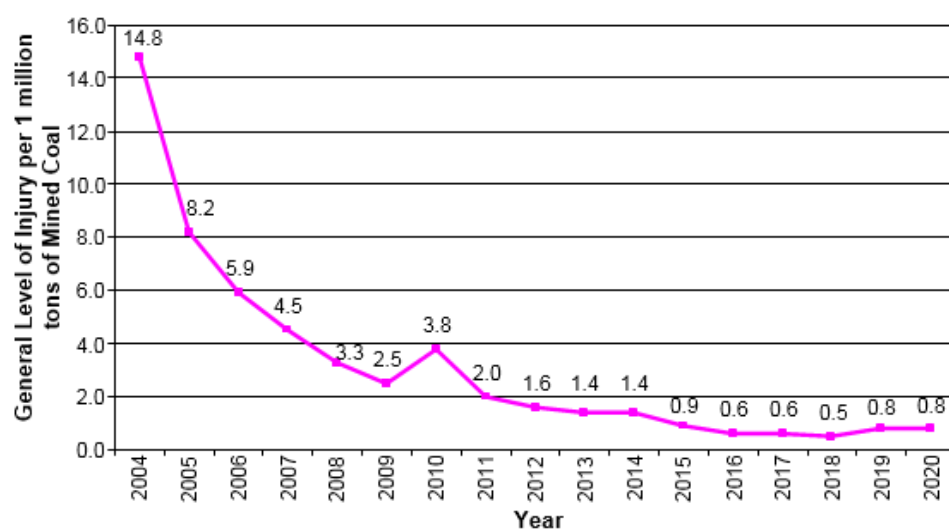
The strategic goal in the field of industrial safety and labor protection is to preserve the life and health of the Company's employees, employees of contractors, and visitors to the Company in the course of work.

Investments in the technical re-equipment of coal mining, service, and infrastructure enterprises for 16 years exceeded 263.7 billion rubles, including technical security—29.3 billion rubles [50].

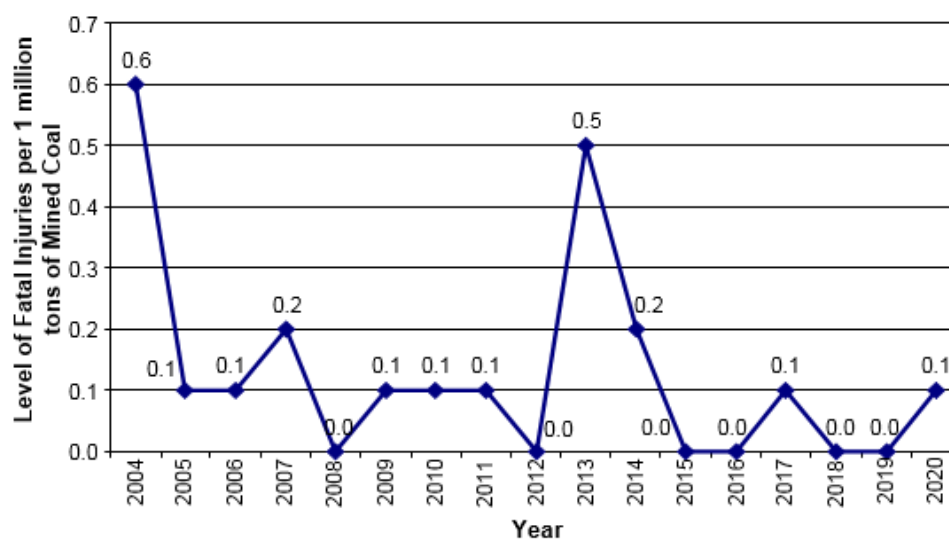
Thanks to these investments, favorable conditions have been created at the SUEK-Kuzbass JSC enterprise to ensure the safety of personnel, while over 16 years (from 2004 to 2020), the level of general injuries has decreased by 95%, which indicates the large-scale work done in the field of industrial safety and labor protection.

As a confirmation of the effectiveness of the above measures, one can cite, as an example of stable dynamics, the decrease in the general injury rate per 1 million tons of mined coal since 2004 (Figure 3a). However, after that, the rate of decline slowed down, and, as can be seen from the graph, starting from 2015, it reached a stable level with further slight growth in 2019–2020, which indicates the need for a deeper study of the root causes and factors.

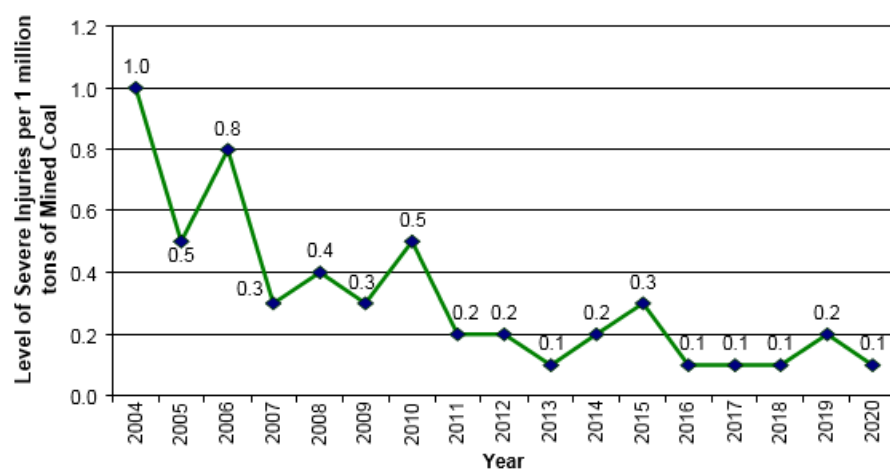
A detailed study of the trend in the fatal level of injuries at Russian enterprises allows the conclusion that individual accidents, characterized by a large number of victims, have a significant impact on the above dependence. The graph shows a peak in 2013 (Figure 3b), which reflects the fact of a methane explosion at mine No. 7—an accident with ten injured people, including eight fatalities. Analyzing the previous period according to the statistics of similar accidents at all coal mines in Russia, it can be noted that the tendency to reduce such accidents has a much slower pace than in other areas. Thus, the level of general and fatal injuries has not been reduced to zero on a permanent basis, although in 2008, 2012, 2015–2016, and 2018–2019, the level of fatal injuries had indicators close to zero.



(a)



(b)



(c)

Figure 3. Dynamics of the injury rate per 1 million tons of mined coal. (a)—the general level of injury; (b)—the level of fatal injuries; (c)—the level of severe injuries (compiled by the authors).

Analyzing the dynamics of severe injuries per 1 million tons of mined coal (Figure 3c), one can also note a decrease in this value by 80% in the period from 2004 to 2020. However, here, this trend is not constant, since in some years an increase in injury rates was observed (peaks in the graph in 2006, 2010, 2015, 2019, and 2020).

Thus, as the main conclusion from the above, it can be noted that this issue has not yet been fully resolved, and the methods and means of ensuring safety in the company SUEK-Kuzbass at present do not provide the previously observed rates of injury indicators decrease.

In general, on the basis of the obtained trends in the dynamics of the level of injuries, it can be concluded that they are exponential, while the dependence tends to a value other than zero. It should be noted that the analysis of such trends within a characteristic time interval shows that with a planned, consistent, and targeted application of measures to ensure the safety of personnel, this value decreases. In this case, the selected time interval must correspond to any new measures or technical solutions being introduced to ensure labor safety.

This allows the conclusion that in the long term, during which it is planned to reduce the injury rate to zero values, the dynamics of the injury rate in the presence of a number of such time intervals will be stepwise. The established nature of the dependence has scientific novelty and practical significance for the development of targeted measures to reduce the level of industrial injuries in a particular enterprise.

Based on the analysis of statistical indicators of industrial injuries in JSC SUEK-Kuzbass, two key causes of injuries can be identified: systemic causes and the so-called “human factor”.

In this regard, the Vision Zero concept can be used as a tool that contributes to the effective functioning of the OSH system in the organization.

In accordance with the “Golden Rules”, the Vision Zero manual [51–53] has developed a test list that helps to determine whether the organization of safe work at the enterprise complies with the principles of the concept of zero injuries. With the help of test lists [54–56], decision-makers determine which problems need to be worked out.

Despite the fact that all seven “Golden Rules” are closely interconnected [57,58], they can be implemented in the work of an organization separately. The test list for each rule contains several blocks of statements, which are assigned a label according to a color scale:

- red—“action needs to be taken”;
- yellow—“there is something to work on”;
- green—“fully implemented”.

After the employees have analyzed all the statements of each block, the actual state of affairs within the framework of a separate rule can be assessed on the same scale. The result of working with assertions reveals a specific set of problems. In the course of working out the rules for eliminating each problem, a goal is formulated to be achieved. The next stage is the development of an action plan, for the implementation of which the implementation period is set and a responsible person is appointed from among the leaders or specialists of the labor protection service in the departments.

The goals are considered achieved if the organization adopts a local normative act that corresponds to the assertions of the concept. If there are reasons that prevent this, then an analysis of the decisions made is carried out, on the basis of the results of which the order of actions is adjusted, which is agreed upon by the management of the organization as a repeated initiative.

Golden Rule 1: Take leadership and demonstrate commitment.

The significance of this rule can be conveyed by the well-known phrase “the flock copies the behavior of the leader”. At the same time, all managers from the highest to the line level should set an example to follow, i.e., a leadership skeleton should be formed at all management levels, which was noted as a necessary means of implementing this rule in the company SUEK-Kuzbass [50]. Leaders set the rules and follow them themselves. No safety program will work effectively without demonstrating by personal example the adherence

of the first person to the declared values, since employees simply will not believe in the sincerity of the statements made and will doubt the need for the implemented measures.

In fact, following this rule establishes the responsibility of management for the safety of their facilities. At the same time, the leader, by example, prioritizes safety and encourages safe behavior.

Golden Rule 2: Identify hazards and control risks.

This rule is to identify the hazards and risks associated with production activities by:

- systematization of the risk assessment process;
- improving the quality of hazardous industrial situations registers;
- identification, assessment, and control of diseases and accidents associated with production activities;
- identification and control of incidents and management of hazardous situations that did not lead to accidents and accidents.

As part of the implementation of this rule in JSC SUEK-Kuzbass, all of the above situations should be registered with a subsequent analysis of their causes, even if they did not lead to temporary disability of employees and equipment downtime.

An important basis for following this rule is carrying out work on systematic and regular hazards identification and risk assessment; establishing appropriate mitigation measures and monitoring their implementation and effectiveness; and consideration of factors such as mental stress, overload, overtime, etc. A prerequisite is also adherence to the order of priority in the selection of risk management measures.

Golden Rule 3. Define targets and develop programs.

Emphasis and priority-setting in the updating of the security goal and objectives should be carried out with the participation of the employees of the organization and their representatives, which will make the security process more sustainable and effective, as well as legally justified. At the same time, effective internal exchange of information and timely feedback are significant success factors in JSC SUEK-Kuzbass.

Within the framework of the policy in the field of labor protection and industrial safety, the following should be implemented:

- clarification of goals and objectives among employees of the organization;
- extending its purpose to contractors;
- establishment of regular monitoring of safety and health indicators of workers;
- suppression of unsafe behavior by holding parties responsible;
- encouragement of compliance with industrial safety and labor protection requirements.

Golden Rule 4. Ensure a safe and healthy system and be well-organized.

A detailed study of the industrial injuries' causes shows that the majority of industrial accidents are not related to technical problems, but rather due to organizational failures and "human factors". At the same time, the main necessary requirement for ensuring safety is to improve the quality of the production processes organization, which is achieved by comprehensive measures, the result of the implementation of which is the elimination of hazardous production situations. Among the main measures that are relevant in the company SUEK-Kuzbass, one can single out clearly assigned duties and responsibilities of performers, staff acquisition of the necessary competencies, systematic discussions and briefings in the industrial safety field, and practical training on behavior in emergency situations and first aid.

A separate aspect within the framework of this rule should be safety support when introducing new technologies and in the course of attracting external or partner companies.

The creation of an occupational safety and health system involves the fulfillment of the necessary conditions:

- ensuring the required competencies and knowledge of personnel for safe work;
- a clear distribution of duties and responsibilities of employees;
- resources allocation to attract external experts for consultations.

Golden Rule 5. Ensure safety and health in machines, equipment, and workplaces.

The fifth rule is to fulfill the requirements of industrial safety and occupational health for production facilities, machinery and equipment, workplaces, and collective and personal protective equipment. Implementation measures should be carried out on a regular basis without fail for the enterprise as a whole, technology, and equipment. In a large company such as JSC SUEK-Kuzbass, in the case of complex measures' implementation, the priority order should be followed depending on the problem being solved: technical solutions or organizational measures. At the same time, in any case, the use of personal protective equipment (PPE) is the last barrier to protect workers from exposure to harmful production factors, when all other measures are not as effective as possible.

To implement this rule, it is necessary to:

- ensure timely maintenance of equipment in accordance with the operational documentation;
- use technologies that protect workers from the effects of harmful production factors;
- use high-quality PPE.

Golden Rule 6. Improve qualifications and develop competence.

This rule means that the company's employees must regularly undergo advanced training, and the company must formulate clear requirements for the competence, theoretical knowledge, and skills of employees, which are necessary to ensure the safe production of work.

The development and provision of the necessary competence of JSC SUEK-Kuzbass employees can be achieved through:

- justification of the competence level for each profession;
- targeted training of employees;
- an objective assessment of the employees' level of knowledge.

Golden Rule 7. Invest in people and motivate by participation.

Employees doing their jobs are the most knowledgeable about safety issues in their work area. As a result, an effective measure is to organize a survey of the JSC SUEK-Kuzbass' personnel about their ideas for improvements in industrial safety and possible risk minimization associated with their work. Moreover, it is essential for effective leadership, productive communication, and a sustainable corporate culture.

Working with personnel based on their motivation in the field of safety implies:

- changing the workers' attitude to safety from passive to active;
- using employee suggestions to improve safety;
- encouraging safe behavior.

Initially, the Vision Zero strategy was developed for representatives of the mining industry; therefore, all information about this program was initially posted on the ISSA industry portal dedicated to this type of activity [59].

To ensure the objectivity of the achievement degree assessing of goals and solving the tasks set, a set of indicators (target indicators) is used that characterizes the annual progress and program results, the list of which, as well as the methodology for calculating them, is presented in Table 2.

The assessment of the implementation level of the program is made by comparing changes in the actual indicators values characterizing the annual progress and results of the program activities implementation, relative to their baseline values, with changes in the planned (forecast) values of indicators relative to their baseline values. The values of indicators for the year preceding the year of the start of the program are used as the baseline. To achieve positive results, the planned (forecast) values of indicators should differ from the baseline in the direction of improvement.

The assessment of the level of implementation of the program activities is carried out annually during the entire period of the program implementation and in general after the end of its implementation and is carried out for each indicator according to Formula (5).

$$E_i = \frac{X_i^0 - X_i^{cur}}{X_i^0 - X_i^{plan}} \cdot 100\%, \quad (5)$$

E_i —the level of progress in the activities' implementation of the subprogram for the i -th indicator (in percent);

X_i^0 —the base value of the i -th indicator;

X_i^{cur} —the current value of the i -th indicator;

X_i^{plan} —the planned value of the i -th indicator.

Table 2. Target indicators for achieving the goals and solving the program objectives.

No.	Target Indicator Name	Methodology for Calculating the Target
1	Industrial injuries frequency rate C_f (the number of industrial accident victims with disability for one working day or more and with a fatal outcome per 1000 workers)	The value of the indicator is calculated by Formula (1). $C_f = \frac{C_{vict.}}{C_{work.}} \cdot 1000 \quad (1)$ $C_{vict.}$ —the number of industrial accident victims with disability for one working day or more and with a fatal outcome in the reporting year; $C_{work.}$ —the average number of employees in the reporting year.
2	Frequency rate of fatal industrial injuries C_{ff} (the number of industrial accident victims with a fatal outcome per 1000 workers)	The value of the indicator is calculated by Formula (2). $C_{ff} = \frac{C_{f.vict.}}{C_{work.}} \cdot 1000 \quad (2)$ $C_{f.vict.}$ —the number of fatal accident victims at work in the reporting year; $C_{work.}$ —the average number of employees in the reporting year.
3	Occupational disease incidence OD (number of occupational diseases per 10 thousand workers)	The value of the indicator is calculated by Formula (3). $OD = \frac{C_{OD}}{C_{work.}} \cdot 10,000 \quad (3)$ C_{OD} —the number of occupational diseases in the reporting year; $C_{work.}$ —the average number of employees in the reporting year.
4	The proportion of workers employed in work with harmful and (or) hazardous working conditions in the average number of employees P_{hlc}	The value of the indicator is calculated by Formula (4). $P_{hlc} = \frac{C_{hlc}}{C_{work.}} \cdot 100\% \quad (4)$ C_{hlc} —the number of employees employed at work with harmful and (or) dangerous working conditions in the reporting year, $C_{work.}$ —the average number of employees in the reporting year.

3. Results

Due to the complex organization of the Russian labor protection system, a large number of requirements in it can become an obstacle and slow down the Vision Zero principles' implementation. It is necessary to work on this very seriously; otherwise, the Golden Rules of Vision Zero may simply get lost in this huge volume of requirements. As a consequence, employees will not be aware of their main ideas or will simply ignore them.

At the initial stage, the Vision Zero concept implementation should be anticipated by an assessment, the results of which will give an understanding of what has already been done in the company for labor protection and what still needs to be done.

The goal achievement and assigned task solution of the concept are carried out through the coordinated program activities' implementation.

The activities list of the Vision Zero concept corresponding to the goals and objectives, relevant for the JSC SUEK-Kuzbass' production conditions as well as the deadline for their implementation, are given in Table 3.

Analyzing the data shown in Table 3, three categories of persons whose actions represent the so-called "human factor" can be distinguished: the leaders of the organization, specialists in the labor protection field, and employees, whose activities are not directly related to the collective safety issues.

Table 3. Activities list of the Vision Zero concept program (compiled by the authors).

No	Activity	Deadline
1. Increasing the Management Responsibility for Labor Protection		
1	Sending the head of the organization and heads of structural departments of the organization to training on labor protection issues.	In accordance with the approved schedule
2	Inclusion of OSH issues on the agenda of all meetings of the organization (first item on the agenda).	Constantly
3	Personal meetings of the head of the organization with employees to discuss labor protection issues.	In accordance with the approved schedule
4	Audits of compliance with labor protection requirements by the head of the organization and the heads of all structural units (the form of audits is determined by the head).	In accordance with the approved schedule
5	Questionnaire survey of employees on the issue of assessing the management activities in the labor protection system.	As needed
6	Conclusion of agreements with the structural units' heads of the organization, including obligations regarding improving working conditions and labor protection.	As needed
2. Threat Identification and Risk Control		
7	Special assessment of working conditions.	In accordance with the Federal Law
8	Updating of risk and threat assessment with the subsequent prevention programs development (preventive measures).	Annually
9	Immediately informing the head of the organization about industrial accidents, pre-emergency situations, and potentially dangerous incidents at the enterprise that are harmful to the organization's employees' health.	Constantly
10	The investigation of industrial accidents, pre-emergency situations, and potentially dangerous incidents at the enterprise to identify the causes and take preventive measures.	Constantly
11	Spot checks by the head of the organization or a person authorized by him of the preventive measures' effectiveness.	As needed
12	Conducting anonymous online surveys of all levels of employees about the OSH system effectiveness at the enterprise, followed by an analysis of the results.	Monthly
3. Defining the Goal and Programs Development in the OSH System		
13	Development of local legal acts on labor protection (standards, programs, etc.)	As needed
14	Conducting campaigns on occupational safety, health days, and other events on occupational safety issues.	According to the approved schedule
15	Informing workers about the performance indicators in the labor protection system (number of accidents, employees who have undergone training, scope of participation in labor protection days).	Constantly
16	Comparison of key performance indicators of an enterprise in the labor protection system with indicators of similar enterprises in the industry (benchmarking).	The term is set by the employer (if it is possible to implement the event)
17	Development of a mechanism for taking into account indicators in the labor safety system when assessing the potential employee competence.	As needed

Table 3. Cont.

No	Activity	Deadline
4. Safety and Health System Creation		
18	Updating the OSH system	As needed
19	Updating the contingent employees list subject to preliminary and (or) periodic medical examinations.	As needed
20	Updating labor contracts (in terms of labor protection issues) and labor protection instructions.	As needed
21	Conducting practical activities related to emergency situations, which practice action skills in emergency situations.	According to the approved schedule
22	Conducting an external audit of the OSH management system, obtaining a corresponding certificate.	As needed
5. Safety and Hygiene Ensuring in the Workplace		
23	Compliance verification of purchased goods, works, services with safety requirements, and availability of conformity certificates.	When accepting goods, works, services
24	Carrying out the equipment safe state inspections.	According to the approved schedule
25	Inclusion of information on the safe operation of equipment in labor protection instructions (in accordance with the specifics of work), as well as in training programs and training sessions.	As needed
26	Implementation of measures for working condition improvement, based on a special assessment of working conditions results.	According to the plan
6. Employees' Professional Development		
27	Training employees at the enterprise in the safe work principles under the guidance of a mentor assigned to him (development of the institute of mentoring).	As needed
28	Ensuring that the employee documents his knowledge and transfers it to successors for further use in work (for example, by organizing joint training).	As needed
29	Sending employees to advanced training courses.	As needed
30	Testing the employees' knowledge in labor protection in the form of tests, surveys, etc.	According to the established schedule
31	"Express tests" on labor protection before starting work (shift) at permanent workplaces.	As needed
32	Organization of a distance learning system for employees on labor protection issues.	Constantly
7. Increasing the Motivation and Degree of Employee Participation in Ensuring Safe Working Conditions		
33	Encouraging employees for high results and safe work, as well as participation in labor protection competitions in the form of financial and non-financial incentives.	Constantly
34	Collection, analysis, and implementation of innovations aimed at improving the working conditions of the employees.	Constantly
35	Development of a positive corporate culture at the enterprise based on trust, respect, and care of employees for each other.	Constantly
36	Employees reviewing with possible risks to their health and measures for their prevention.	As needed

4. Discussion

Focusing on the activities of the above categories of persons, it is necessary to take into account the following circumstances, the presence of which determines the effectiveness of the Vision Zero program implementation. According to statistical studies, over 80% of accidents are directly or indirectly caused by the actions of workers who do not have enough knowledge and experience to perform many types of work in the modern production field [1–3].

Therefore, there is no doubt that it is necessary to solve problems related to the professional development of all employee categories, and not only in the rather narrow area of their direct responsibilities, but also in a wider sector, covering the activities of the entire enterprise. Obviously, to do this, it is necessary to have modern methodological support and software, which includes safety issues at all technological cycle stages. At the same time, its use should not cause discomfort among employees caused by the threat of an unreasonable assessment of their professional competence or the actions performed.

Currently, the technologies for managing the production cycles of the enterprise are being introduced, the safety systems of which include subsystems that ensure the increase and continuous monitoring of the workers' competence as production develops. The implementation of these solutions in the labor safety field has already brought positive results. Statistical studies of recent years have shown that the practical use of digital technologies in the occupational safety management system to improve the competence of workers at large industrial enterprises has provided a significant reduction in the number of injuries at work [4–6].

Based on the analysis of the existing dynamics of reducing injuries, it can be concluded that the implementation of the Vision Zero program in the production conditions of JSC SUEK-Kuzbass, combining the above measures, will be an effective tool, the use of which will lead to the fact that the values of target indicators will steadily decrease, approaching zero values in the future.

However, the dynamics of such a process substantially depend on many factors. As mentioned above, there are two groups of causes of injury: systemic causes and "human factors". At the same time, the causes and sources of accidents at mining enterprises are globally divided into three groups: natural, technical, and organizational.

The system group includes all the reasons associated with the technology and organization of work. Their percentage of the total number of causes can fluctuate in a significant range, which is established during the investigation of a specific accident. These causes are mainly characterized as contributing or concomitant to the conditions under which an accident occurs. Therefore, to reduce their degree of influence, the following activities of the Vision Zero concept are most effective: identification of threats and control of risks, setting goals and developing programs in the field of occupational safety and health, creation of a safety and health system at work, and ensuring safety and hygiene in the workplace (Table 3).

As for the "human factor", its share, as a direct cause, in some statistical samples is up to 50%, and the share of indirect influence can reach 48%. Thus, it has a predominant influence and, in fact, is always the main one, with the exception of the so-called "force majeure" cases' impact, which can be attributed to the action of natural and partly technical factors. At the same time, the ability of a person to manage the situation, aimed at preventing the occurrence and development of accidents, in some conditions can be significantly limited and does not exceed 30%.

Obviously, in order to reduce the influence of the "human factor", the most relevant measures of the Vision Zero concept, which directly affect the company's personnel, include increasing the management responsibility for labor protection, advanced employee training, and increasing motivation and the degree of employee participation in ensuring safe working conditions (Table 3).

Based on the comprehensive analysis of the given data interrelation on the causes and sources of hazards, carried out by the authors, it can be concluded that the structure of the interconnection of many accidents' causes and group accidents is complex [2].

As an example, it can be noted that for the SUEK-Kuzbass JSC mines, one of the largest accidents in terms of the consequences is gas and dust explosions in mines. As the results of the investigation of such accidents show, in all cases except the immediate one, several interrelated causes of the explosion were noted. For example, if the immediate cause of the explosion was the ignition of gas from electrical equipment, then, in addition, a number of causes contributing to the accident are always established. Among them, it can be noted that the technical reason is faulty equipment and organizational reasons include unsatisfactory control of mine ventilation and of faulty equipment operation.

It is obvious that in order to most effectively reduce the accidents' probability, it is necessary to exclude the influence of all causes—direct, contributing, and concomitant. A comprehensive solution to this problem, according to the authors, is capable of ensuring the implementation of the Vision Zero concept measures.

5. Conclusions

The article highlights the history of the emergence and development of the Vision Zero strategy from the corporate to the international level, as well as the goals and objectives of the concept of “zero injuries” as a global policy in the field of industrial safety.

In world practice, Vision Zero is the quintessence of optimal actions to minimize the risk of accidents and accidents that companies need to apply to achieve their goals. The seven Golden Rules given in the article are the basis, which is necessarily accepted as a guide to action by the forces of a company whose policy is aimed at implementing the Vision Zero concept in production conditions. At the same time, it is taken as a necessary condition for the company to implement the entire complex of measures, the result of which will be work with a minimum level of injuries, the indicators of which tend to zero values over a long period.

To substantiate the urgency of the problem, the authors analyzed injuries at coal enterprises of the Russian Federation and studied the performance indicators of the concept in production conditions. A list of activities and target indicators of the program is proposed for the implementation of the goal and fulfillment of the Vision Zero concept tasks on the example of one of the largest coal companies—JSC “SUEK-Kuzbass”.

The choice of the enterprise was based on the fact that the identified problems and issues of ensuring personnel safety have not yet been fully resolved. The analysis of working conditions showed that the methods and means of ensuring safety in the company JSC SUEK-Kuzbass have almost completely exhausted their potential for further reduction of injury rates.

The established stepwise nature of the dependence of the injuries' level dynamics in the presence of time intervals whose numbers correspond to new measures or technical solutions to ensure labor safety has scientific novelty and practical significance for the targeted measures' development to reduce the industrial injuries level in a particular enterprise.

The Vision Zero program activities list corresponding to the goals and objectives that are relevant for the JSC SUEK-Kuzbass production conditions, as well as the deadline for their implementation, and the concept task solution is given. The article also provides recommendations on the timing of an indicator set (target indicators) characterizing the annual progress and results of the program implementation to ensure the objectivity of assessing the achievement degree of goals and solving the tasks.

At JSC SUEK-Kuzbass, Vision Zero can become the basis on which scientific and practical approaches to solving complex problems in the labor protection system will be formed. At the same time, the implemented measures will lead in the long term, in a fairly short time, to positive dynamics in injury reduction only in the case of their comprehensive and targeted application.

In the future, practically all enterprises in the mining and processing, metallurgical, and other industries can be involved in the Vision Zero concept implementation in Russia. Their distinctive feature is the complex nature of potential accidents and high rates of

injuries, including fatal ones. For such enterprises, this concept implementation can be carried out on a legislative basis.

To improve the efficiency of the Vision Zero concept solutions, in each case, it is necessary to perform a preliminary analysis of industrial safety and labor protection, assess the need and sequence for a complex or individual targeted measures' application, and develop control mechanisms.

The analysis of mining enterprises' specifics showed that the following measures of the Vision Zero concept are most relevant to reducing the impact of accidents' systemic causes: identification of threats and control of risks, setting goals and developing programs in the field of occupational safety and health, creation of a safety and health system at work, and ensuring safety and hygiene in the workplace. To reduce the influence of the "human factor", the most effective measures of the Vision Zero concept are those directly related to the company's personnel: increasing the management responsibility for labor protection, advanced employee training, and increasing motivation and the degree of employee participation in ensuring safe working conditions.

The main conclusion based on the results of the research is that the Vision Zero concept is an effective tool that contributes to effective OSH management system formation.

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Appendix A. Examples of Stages in the Vision Zero Strategy Formation at the Corporate and State Levels

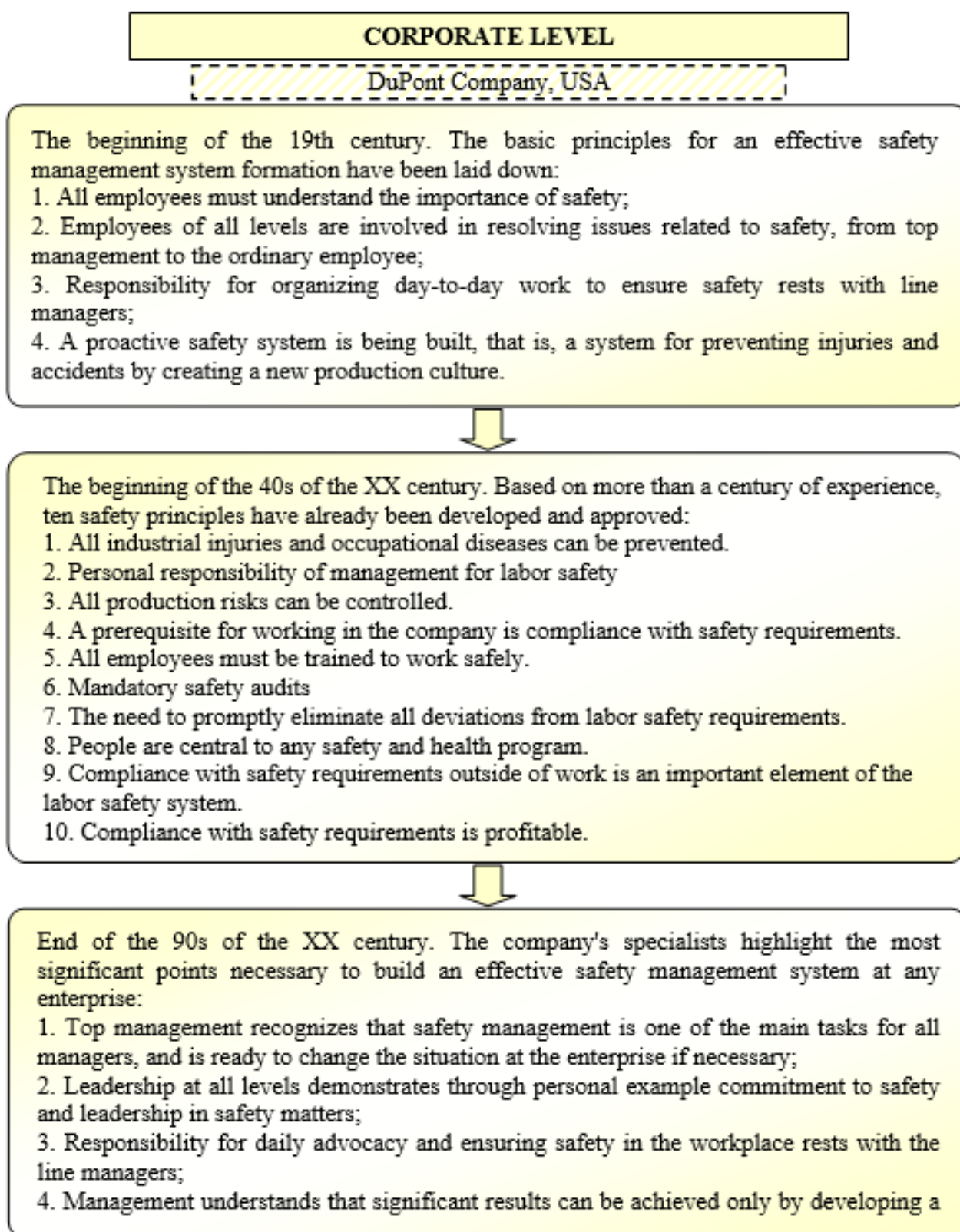


Figure A1. Corporate level of development and implementation of the Vision Zero strategy at DuPont, Wilmington, DE, USA [20].

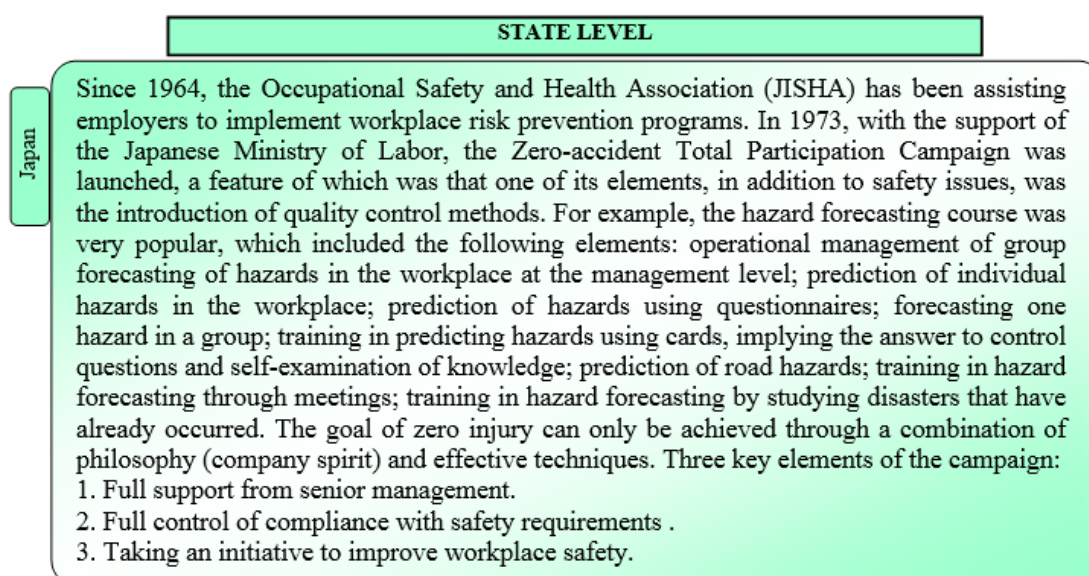


Figure A2. Development and implementation of the Vision Zero strategy in Japan [20,23].

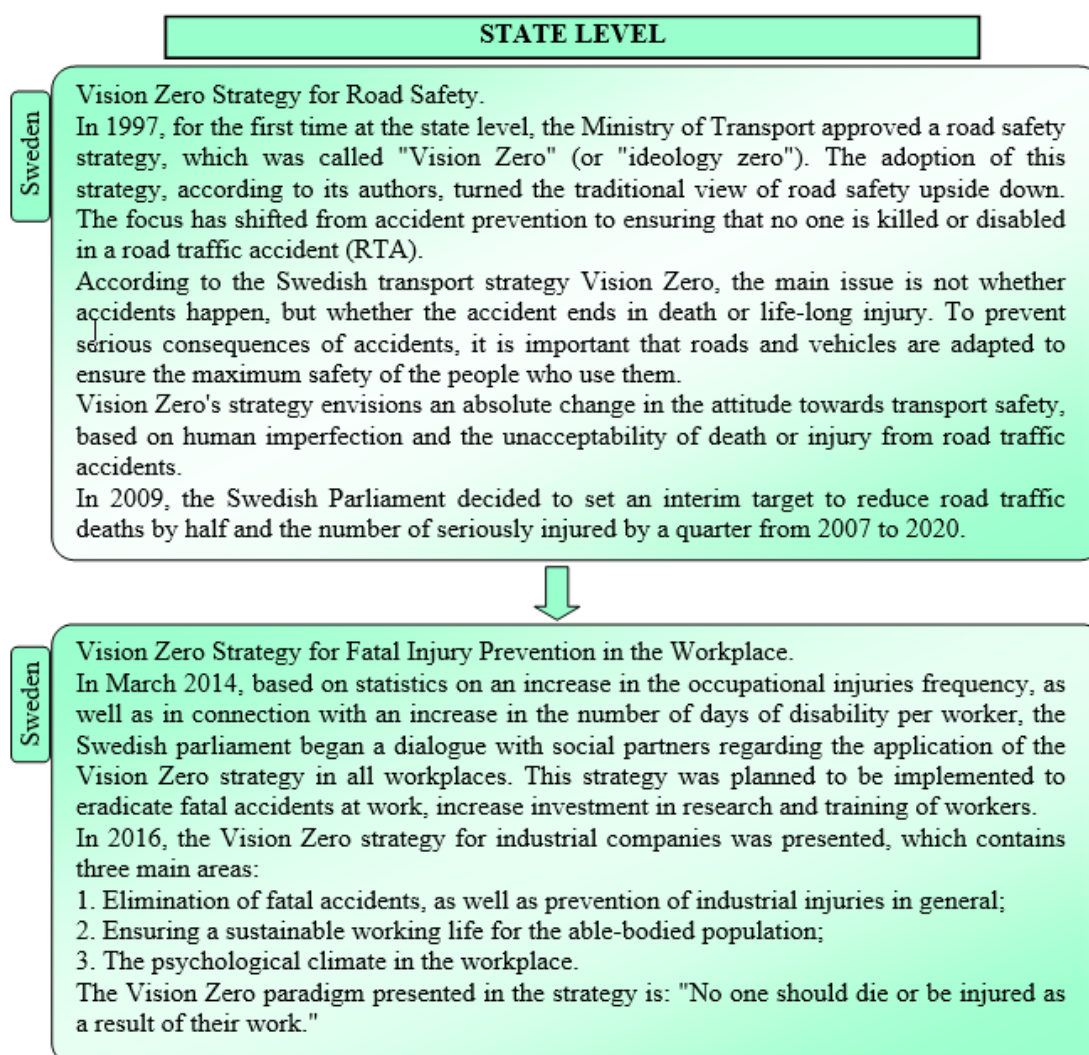


Figure A3. Development and implementation of the Vision Zero strategy in Sweden [20,21,26].

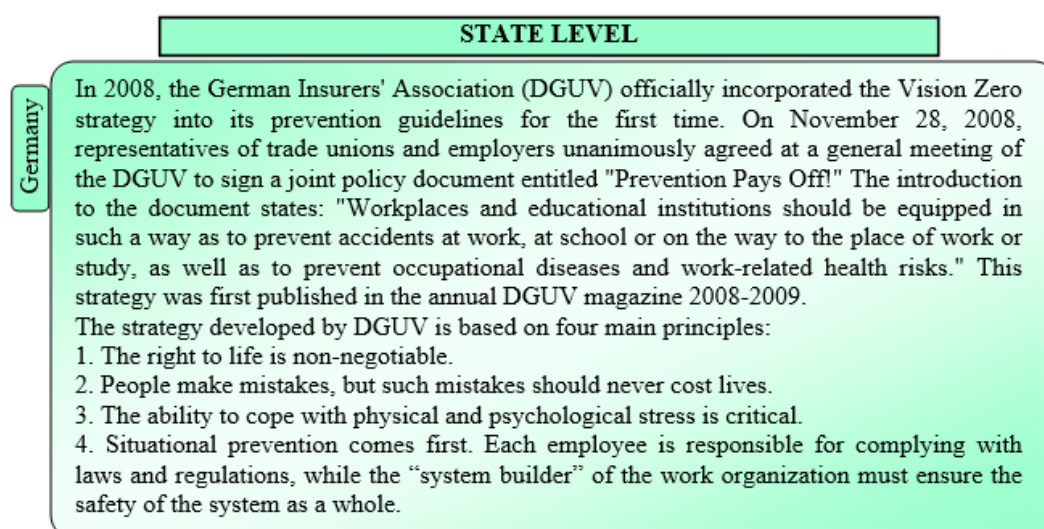


Figure A4. Development and implementation of the Vision Zero strategy in Germany [20,24,25].

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