



# Mining Company Management in Case of the Epidemic Emergency

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## Abstrakt

*The date assumed as the beginning of the pandemic in Poland is March 4 2020, the date of the first confirmed case of the virus. The article presents the actions undertaken by the management of underground hard coal mining plants concerning the risk of epidemic related to SARS-CoV-2. This work shows a set of implemented recommendations, guidelines and decisions which were established after the appearance of the first wave of cases in Poland. What is more, it discusses measures aiming at reducing the risk of spreading the coronavirus among the mineworkers. The suggestions for different variants of the decision-making process concerning the pandemic and which have an enormous impact on the operating expenses of the company are also made.*

**Keywords:** mining company, epidemic emergency, coronavirus SARS-CoV-2, safety

## 1. Introduction

Ensuring safe mine (mining plant) operation and proper working conditions of the employed are the foundations for the functioning of a mining company in terms of its sustainable development. It is particularly important for hard coal mining, where the working environment is shaped by geological and mining conditions, natural hazards and conditions resulting from the specificity of work in underground excavations [Sukiennik et al., 2019b].

Mine operation, whether as an independent unit or a part of a multi-facility mining company, is shaped by the following elements:

- technical and organisational,
- economic,
- social,
- legal.

Managing mine company, and in fact, managing the risks associated with operating in such an environment, is a serious challenge for the company or mine managers and engineers and technicians. The risk does not only assess the probability of occurrence of hazards resulting from conducting mining works but, above all, the effects generated by these hazards [Sukiennik et al., 2019a].

This is due to the geological and mining conditions and the adapted technological specificity of the mining production process. It is carried out within the area of a disturbed rock mass, mostly involving high pressure and resulting from it seismic, gas (especially concerning methane), fire and water hazards. Therefore, the threat to the safety of the employees working in underground excavations arises from many factors [Konopko, 2010]. The influence of geological and mining factors on the risk of work safety in underground mines has been the subject of numerous studies carried out for many decades. This is the reason why these issues are described in literature and regulated by many formal and legal acts, often in great detail.

At the end of 2019 in China, and in March of the following year in Poland, the epidemic emergency associated with the spread of the coronavirus SARS-CoV-2, causing acute respiratory disease COVID-19, emerged. It was acknowledged to be very easily transmitted from one person to another. The virus is mainly transmitted by the droplets created, when a person infected coughs, sneezes and exhales. These droplets are too heavy to float in the air, so they fall quickly on surfaces. Then a person may become infected after touching the contaminated surface followed by touching their eyes, nose or mouth.

The risk of a severe course of the coronavirus disease appeared to be serious and led to making high-level decisions concerning the announcement of the state of epidemic emergency in the Republic of Poland commencing 14 March 2020 and the state of epidemic commencing 20 March 2020 [Regulation 2020a, 2020b, 2020c]. According to the above-mentioned regulations, radical measures concerning isolation of the inhabitants of our country were implemented. The isolation involved mainly the large scale, temporary suspension of their activities, especially closures of many businesses, offices, schools and retail outlets. Whenever it was possible, the so-called remote working system was implemented.

This created a dilemma – what decisions to make and what will be the consequences for mining companies and mines? These decisions were left to be made by the coal companies and mines managements. These had to be made having insufficient information concerning a threat of this kind, which actually "only just" emerged. Therefore, what decisions need to be made (as soon as possible) with regard to the functioning of mines, without having any reliable knowledge about the sources of the spread of the threat itself and methods of preventing it? And the knowledge of the risks involved is essential at each mining company management level. Although it would be more favourable to implement decisions that would involve "no risk", the basis of the security concept involves "acceptable risk". If it is adopted in relation to a mining com-

pany, it is necessary to anticipate and predict the possibility of occurrence of a risk. This term should be understood as a risk included between the desired upper and lower levels of safety taking into account a set of necessary criteria. In this case, the criteria should concern epidemic emergency in relation to the employees.

The scale of the problem may be evidenced by the fact that by the 10th July 2020, more than 6,500 employees of all mines located in Silesia (less than 9% of all employees) were infected with the coronavirus. The only mine where no case of infection has been reported is LW Bogdanka SA located in the Lublin Province.

## 2. Issues concerning making decisions concerning hazards present in a mining plant (mine)

Although there are many definitions of the term "management", for the purpose of this work it can be assumed that, in the management system of a mining company, there are five management functions: planning, organising, leading, inspecting and improving. However, the management process often involves complex networks of management and executive activities. The whole process consists of three stages: selection and analysis of source data (1), decision-making planning (2) and decision-making (3). The last of these stages involves a very high level of responsibility on the part of the decision-maker as the effects of their decisions, in most cases, might be "extremely costly".

The mining production process consists primarily of a selection of the applicable technology for mining the deposit while maintaining occupational safety. Concerning the management of a mining company and its individual mines, particularly vital are decisions involving [Dubiński et al., 2017]:

- ensuring high standards of occupational safety,
- implementation of modern technical and technological solutions for deposit mining,
- ensuring the required quality of commercial coal produced,
- protection of the mining area where the effects of the carried out mining and the natural environment may be visible.

Additionally, from an economic point of view, the mining production process should be efficient, or at least not generate financial losses. Such requirements for mining production are shown in Figure 1.

In hard coal mining, the basis for decision-making are the laws, regulations, guidelines and various rules and procedures developed. In many cases, those are established based on the past experience and are often supported by scientific research. These regulations are, or at least should be, well known to individual decision-makers. This allows for proper management of a mine and a mining company - proper, i.e. in a way that ensures the highest possible level of safety and avoids unjustified risks concerning mining production.

There is no alternative concerning occupational safety related to the conditions of currently occurring and recognised risks, both natural and resulting from the technologies used. The most important document on basis of which mining plants operate is Mining Law [Act, 2011] which contains provisions stating that:

- "Mining plant operations shall be performed in pursuance of the provisions of law, in particular in pursuance of the mining plant operations plan and in compliance with mining principles",
- "A mining plant operations plan shall specify: (...) detailed projects required in order to ensure: (...) public safety, fire safety, safety to persons in a mining plant, in particular occupational health and safety projects...".

Then, on the basis of this act, a number of regulations were developed, which define in detail the principles for safe mining in the case of the occurrence of specific hazards. The two most important regulations are:

- Regulation of the Minister of Energy of 23 November 2016 on detailed requirements for operation of underground mining plants (Regulation, 2016)
- Regulation of the Minister of Environment of 29 January 2013 on natural hazards in mining plants where, inter alia, the following hazards: rock bursts, methane, gas and rock eruptions, coal dust explosion, climate-related and water hazards [Regulation, 2013].

The regulations specify the ways of measuring the intensity of individual hazards, classifying them into appropriate classes, categories or degrees, and also specify the number of principles and guidelines on how to carry out mining in case of their occurrence. One should note that failure to comply with the established requirements shall lead to taking appropriate disciplinary measures or even penal consequences.

Many of the introduced principles led to a decrease in efficiency understood as the ratio of the amount of expenditure to the achieved effects [Durlik, 1993]. In a mining company (mine), the achieved effects include primarily the amount of extraction. Depending on the type of hazard and its scale, it may be necessary to:

- incurring increased expenditures on taking relevant preventive measures concerning each of the hazards and/or
- reduction of the amount of extraction due to the slower advancement of work at a face due to the hazard related to rock bursts, methane or gas and rock eruptions.

As mentioned above, there is no alternative nor price for occupational safety. The principles established for mining are always implemented in case of occurrence of any hazard. If the expenditures proved mining deposits, outcrops or their parts to be unprofitable, the alternative for decisions made does not only involve abandoning them but discontinuing work in the entire area.

However, how to make rational decisions facing unknown threat? In this case, the problem is to determine how and using which parameters to diagnose the status, how to adopt an action plan and how to implement it. In general, depending on the point of view, the assessment of the same phenomenon, process or subject vary considerably. The correctness of decisions made depends on many factors, including the reliability of available data, predicted conditions of an epidemic, mining



Fig. 1. Features of standard for carrying out mining production process. Source: own study based on [Dubiński et al., 2017]

Rys. 1. Cechy modelowego prowadzenia procesu produkcji górniczej

and technical situation in a mines, knowledge and experience of a company's management and mine management. For this reason, decisions made voluntarily are subject to great risk.

### 3. Measures taken concerning the existing epidemic emergency

As opposed to other hazards, in the case of an epidemic emergency caused by the SARS-CoV-2 there are no specific procedures that could be strictly followed in the operation of a mining company. For example, the Website of the Republic of Poland provides only five general guidelines [www.gov.pl/web/koronawirus]:

1. Regularly wash your hands with soap and water.
2. Cover your mouth and nose with your bent elbow or tissue when you cough.
3. Avoid touching your eyes, nose and mouth.
4. Stay at least 2 meters from other people
5. Stay home.

Rules formulated in such way imply that the primary mean of protection against becoming infected is to keep a distance from other people or even to avoid any contact at all. Implementation of such rules is absolutely not feasible in mines where the limited space of shaft hoist cages, underground means of transport and excavations, where a large number of people work, make it impossible to maintain two-meter space between people.

On 24 March 2020 the secretary of state in Ministry of State Assets met with the presidents of the coal companies via teleconference during which the guidelines to be followed in mines, concerning the spread of coronavirus, were developed. The most important guidelines implemented during work in individual mining plants were:

- reducing the number of work shifts and reducing the work time to six hours,
- limiting the number of people entering the shaft hoist cage and transported using transport equipment by half,
- appointing crisis management centres that decide, depending on the turn of events, on the current decision-making in a company and its mines,
- introducing screening among employees of mines with highest number of cases.

For employees entering mines, temperature measurement points were established. In some mines testing of thermal cameras in order to remotely measure the temperature of people entering them was started.

Further guidelines on procedures were developed by the Team for Managing Crisis in Underground Mining Plants (Polish: Nadzwyczajny Zespół ds. Zagrożeń w Podziemnych Zakładach Górniczych) appointed by the President of the State Mining Authority. These include, among others:

- imposing the obligation on the mining plant operation managers to develop and implement new principles for transporting people using shaft hoists and in underground excavations, along with procedures for disinfecting shaft hoist cages, mine rail cars and other means of transport,
- the obligation to develop, for each mine and their operation, procedures concerning suspected or confirmed cases of SARS-CoV-2,
- appropriate organisation of the use of baths and other places located on the surface of the mines where there are concentrations of people,
- preparation for each mine one or two places where sufficient amounts of disinfectants will be stored,
- the need to place strong emphasis on the use of appropriate protective clothing and other personal protective equipment (masks, goggles, gloves) by employees.

Initially, attempts were made to limit the number of employees working at the same time by reducing the number of shifts and minimising the number of employees working in particular posts. The aim of such actions was to make disinfection of some posts and baths possible as well as reducing the number of employees working in one place at the same time.

However, these actions did not bring the expected results and in view of the increasing number of confirmed cases among employees, the managers of individual companies made decisions to limit the work of some mines by suspending mining for several days. Still, the number of infected continued to grow rapidly, so this time, a radical decision was made (by the government) to completely suspend the work in twelve selected mines for three weeks. At that time, only

employees checking fire safety of underground excavations went to work. Since 6 July 2020, all mines have been operating normally and now it will be possible to assess whether these actions will help to stop the spread of the virus.

#### 4. Decision-making process in an epidemic emergency

According to numerous studies conducted all over the world on the fight against the threats posed by SARS-CoV-2, there is no chance of its natural extinction. Until an effective vaccine is developed, there is no other way to slow down the spread of the pandemic than to limit the contact between individuals. Therefore, the management of mining companies must adopt such an assumption when making decisions related to their operation.

However, the radical step of stopping the operation of mines cannot be the basis for the proposed solutions. Due to the danger of deformation of underground excavations (including, in particular walls in which the built-in machinery and equipment may be destroyed) and initiation of spontaneous fires caused by coal spontaneous ignition, such a solution cannot be taken into account. It is necessary to find other methods to reduce the number of people in underground excavations. For this purpose, each mine should carry out an in-depth technical and economic analysis of the possibilities of:

1. limiting the number of people working at the face of a mine,
2. limiting the number of faces concerning works mining both drifts and headings, as well as determining the economic effects of such action,
3. decommissioning a certain number of excavations and basic elements, especially shafts and fore-shafts.

The principles and technologies for carrying out certain works often, among others, provide for employing the minimum number of people necessary for their safe operation. Therefore, the procedure aiming at the reduction of the number of people working at faces of a mine cannot involve reducing this number below the required minimum. However, in many cases, there are possibilities to implement modern technical solutions, allowing to reduce this number almost completely. For example:

- using electro-hydraulic controllers for sections of powered supports carried out by only one operator located at a main gate,
- using full visualisation and automation for controlling conveyors transporting mined minerals,
- using a container system for transporting materials - containers loaded on the surface can be transported directly to the face of a mine without the need to reload them on the main transport road.

Another method of reducing the number of employees involves increasing the concentration of production. In many mines, the current amount of extraction is obtained from several simultaneously active longwalls and, considering the average annual, there can be even up to 5 of those. Performing appropriate analyses would provide data on whether there are technical possibilities to increase the extraction from certain longwalls in such a way that the total amount of extraction required could be obtained from fewer longwalls.

Another issue that needs to be investigated by means of economic analyses is the possibility of reducing operating expenses for the required efficiency of production to be achievable in the case of a smaller amount of extraction from fewer longwalls. Concerning this issue, the companies and mines management play a particularly important role. According to the research on:

- market situation – coal marketing opportunity and its price,
- the amount of expenses to be incurred in order to carry out the required works safely,

the decisions made should involve the determination of the very minimum amount of extraction necessary to maintain the efficiency of operation, the number of stopes, equipment needed to mine them, and the number of employees needed to carry out the works.

Addressing the third issue mentioned above, it should be highlighted that currently spatial structure of many mines is overly expanded. This most often concerns the remaining structures used in the period when the extraction of hard coal by the mining industry was more than three times higher than currently. Only parts located peripherally were decommissioned when conducting restructuring activities in the functioning mines, and no changes in the areas of carrying out mining were made. As a result, today there are mines with 7 and 8 shafts and more than 10 levels. If those are maintained but not used during mining, those only generate unnecessary expenses. The regulations require for each excavation to be maintained in a condition which does not threaten the safety and be periodically inspected. Their decommissioning would contribute to reducing both operating costs and the number of employees necessary.

#### 5. Summary and conclusions

The SARS-CoV-2 pandemic caused a shock to the world economy. Production companies, including hard coal mining industry in Poland, were particularly affected by it. Such a situation is the result of the recognition of a new, mass threat to the health and life of mineworkers. Company managers, responsible for the safety of their employees, were almost immediately forced to introduce dramatic changes in the organisation of work in companies.

The first actions performed in the mining plants were mainly related to adapting the activities to the national law resulting from the regulations introducing, first, the state of epidemic emergency, and then the state of the epidemic. At the same time, the mines implemented the recommendations of the Chief Sanitary Inspectorate concerning rules for proper hygiene (e.g. social distancing, disinfection, wearing mask). Due to the further increase in the number of coronavirus cases, organisational changes were made to reduce the number of employees, e.g. in shaft hoist cages or transport machines. In many plants, mass screening was carried out and in some periods, mining was completely suspended. The difficult, from an economic point of view, decisions resulted in bringing the situation under control and stopping the increase of infections by the beginning of July 2020. However, it should be stated that the "remote working" promoted and introduced in many industries is not feasible for implementation in un-

derground mining companies. Therefore, in case of the next wave of the epidemic, previously observed events should be expected to occur. Nonetheless, the introduced procedures and experienced gained while fighting the first wave of the epidemic will undoubtedly allow for more effective crisis management.

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#### *Zarządzanie przedsiębiorstwem górniczym w warunkach zagrożenia epidemicznego*

*Pojawienie się pierwszego potwierdzonego przypadku koronawirusa w dniu 4 marca 2020 roku przyjmuje się jako datę rozpoczynającą pandemię w Polsce. W artykule przedstawiono działania podjęte przez kierownictwa podziemnych zakładów węgla kamiennego w związku z zagrożeniem epidemicznym koronawirusem SARS-CoV-2. Zaprezentowano zbiór wdrożonych rekomendacji, wytycznych i decyzji, które zostały podjęte z chwilą pojawienia się pierwszej fali zachorowań w Polsce. Dodatkowo omówiono praktyczne działania w celu minimalizacji ryzyka zarażenia pracowników kopalń koronawirusem. Wskazano także propozycje różnych wariantów przebiegu procesów decyzyjnych związanych z panującą pandemią, które mają decydujący wpływ na koszty funkcjonowania przedsiębiorstwa.*

**Słowa kluczowe:** przedsiębiorstwo górnicze, zagrożenie epidemiczne, koronawirus SARS-CoV-2, bezpieczeństwo