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RISK MANAGEMENT OF ACTIVATING AND MINING OF A LONGWALL IN A COAL MINE

Summary. This publication presents a method of risk management of a longwall, including identification of risk factors connected with activating and mining of this longwall, measurements and risk assessment, mapping out a response strategy to a risk as well as taking relevant decisions. In the method, there are considered the results of the conducted studies of the experts' opinions for the purpose of determining the risk factors of the longwall, and there are used the devices applied in the risk management of the projects.

Keywords: risk factors, longwall, risk management, coal mine.

ZARZĄDZANIE RYZYKIEM URUCHOMIENIA I EKSPLOATACJI ŚCIANY WYDOBYWCZEJ W KOPALNI WĘGLA KAMIENNEGO

Streszczenie. Artykuł przedstawia metodę zarządzania ryzykiem ściany wydobywczej, obejmującą identyfikację czynników ryzyka, związanych z uruchomieniem i eksploatacją tej ściany, pomiar i ocenę ryzyka, opracowanie strategii reagowania na ryzyko oraz podejmowanie odpowiednich decyzji. W metodzie uwzględniono wyniki przeprowadzonych badań opinii ekspertów dla określenia czynników ryzyka ściany wydobywczej, a także wykorzystano narzędzia stosowane w zarządzaniu ryzykiem projektów.

Słowa kluczowe: czynniki ryzyka, ściana wydobywcza, zarządzanie ryzykiem, kopalnia węgla kamiennego.

1. Introduction

Implementation of production plans of a coal mine requires a precise planning of the process of activating and mining of the longwalls. In practice, this process is carried out on the basis of knowledge and experience of the design teams, which plan a production volume of the bituminous coal from individual walls. However, it should be noted, that because of the uncertainty of information regarding mining - geological and organizational conditions in the mines, the planned and obtained production volumes of the longwalls differ significantly. The studies conducted in 2015 in the selected mines show that an approximate daily discrepancy of coal mining from the analysed 52 walls stands at ca. - 170 t/d and is ca. 7,4% lower in relation to the planned volume. It is worth emphasizing, that the differences in the obtained production results of the longwalls are characterized by a big standard deviation, at a level of 374,1 t/d. This level means a significant amplitude of deviations, which indicates an occurrence of many factors that influence the risk of the longwalls, understood as a possibility of not achieving the planned coal production volume (measured with probability – a chance of occurrence and an effect) in the specified time horizon.

In order to minimize the risk of the longwalls, it should be managed[1]. This management shall include identification of the risk factors connected with activating and mining of a given longwall, measurement and assessment of this risk, mapping out a response strategy to a risk and taking relevant decisions. In this publication, there is presented a method of risk management of a longwall. For the purpose of drawing it up, the results of the conducted studies of the experts' opinions for the purpose of determining the risk factors of the longwall were used as well as the devices applied in the risk management of the projects. It is assumed, that the developed method should be applied on four specified stages of activating and mining of the longwalls. Stage I refers to designing of the mining in a bed, II – refers to the moment of taking a decision on introducing the wall to a scheme of the course of the walls, III - refers to the moment of taking a decision on beginning of a wall reinforcement, which means activating it on a specified date, while stage IV refers to mining – the course of the wall.

[1] Wodarski K.: Zarządzanie ryzykiem w procesie planowania strategicznego w górnictwie węgla kamiennego. Wydawnictwo Politechniki Śląskiej, Gliwice 2009, s. 38; Nahotko S.: Ryzyko ekonomiczne w działalności gospodarczej. Oficyna Wydawnicza OPO,. Bydgoszcz 1997, s. 12; Kaczmarek T.T.: Zarządzanie ryzykiem handlowym, finansowym i produkcyjnym dla praktyków. ODDK, Gdańsk 2002, s. 59; Pritchard C.: Zarządzanie ryzykiem w projektach. Teoria i praktyka. WIG – PRESS, Warszawa 2002, s. 3-5; Tarczyński W., Mojsiewicz M.: Zarządzanie ryzykiem. Polskie Wydawnictwo Ekonomiczne, Warszawa 2001, s. 35-37; Jonek-Kowalska I., Turek M. (red.): Zarządzanie ryzykiem operacyjnym w przedsiębiorstwie górniczym. Wydawnictwo Naukowe PWN, Warszawa 2011, s. 38.

2. The results of the studies for the purpose of determining the risk factors of a longwall

To specify the risk factors connected with activating and mining of the longwall in a coal mine, the studies were conducted, based on a drawn up questionnaire on a lower level of standardization. 78 experts took part in the studies, out of which 74 were workers of a high-level supervision of the 5 chosen Silesian mines and the remaining 4 were researchers from Silesian University of Technology in Gliwice. The questionnaire contained a list of 67 risk factors, connected with activating and mining of a longwall. The list was suggested by the authors of this publication and then it was adjusted and complemented by the experts who took part in the studies.

The purpose of the studies was to determine the risk factors which are relevant on the mentioned four stages connected with activating and mining of a longwall. The way in which the studies were conducted complied with the line of a method of relative importance[2]. The experts were assessed with regard to their competences, and the obtained results - with regard to a consensus. Due to the volumetric requirements of the publisher, only the results of the conducted studies which are characterized by a high level of consensus of the experts' opinions were presented in this publication.

In the opinion of 78 experts, 77 risk factors might be connected with the specified four stages of activating and mining of a longwall (table 1). It is assumed that these factors shall be considered in the method of risk management of a longwall. In particular, in the line of this method, out of the specified 77 risk factors, there should be identified those which characterize a given longwall.

Table 1

Risk factors connected with activating and conducting of a longwall

STAGE I. Designing of the mining in a bed
1. A change of (-) an average density of a coal bed in a longwall
2. A change of inclination of a coal bed
3. A change of the coal quality
4. Tectonic disturbances (washing out, rock inclusions) causing a necessity of mining gangue in a wall
5. Overgrowths of gangue in a bed, total density of which exceeds 30% of the designed bed density
6. Faults, which, with the applied mining technology, can be overcome without a necessity to convert the wall
7. Faults, which, with the applied mining technology, cannot be overcome without converting the wall
8. Methane threat in the area of the planned wall or in the immediate vicinity

[2] Legut W.: Wyznaczenie współczynników względnej ważności parametrów górniczo-geologicznych determinujących wyniki produkcyjne kopalni za pomocą ocen ekspertów - specjalistów. Zeszyty Naukowe Politechniki Śląskiej, s. Górnictwo, z. 88, Gliwice 1979; Męczyńska A.: Grupowa ocena ekspertów w procesach decyzyjnych zarządzania. Zeszyty Naukowe Politechniki Śląskiej, s. Organizacja i Zarządzanie, z. 40, Gliwice 2007; Wodarski K.: Zarządzanie ryzykiem w procesie planowania strategicznego w górnictwie węgla kamiennego. Wydawnictwo Politechniki Śląskiej. Gliwice 2009.

cont. of table 1

9. Emission of methane in quantities exceeding the predicted concentrations, causing a necessity to decrease an intensity of execution of the mining works 10. Emergence of the air temperature in the wall and in the longwall zone workings, exceeding a level of 28°C, which will cause a necessity of the crew's working time reduction 11. Emergence of the rocks fallouts and cave-ins causing technical stoppages of the wall, mine faces in the longwall zone's workings or in the wall cross-cut 12. A threat of an eruption of gases or rocks 13. A necessity to redevelop the workings due to the occurring stresses, swelling of the rocks etc. 14. A necessity to drain the water from the water tanks 15. A water threat posed by the water tanks 16. A change of the bed density causing a lack of technical possibilities of mining of the wall 17. A water threat 18. A rockburst threat (a tremor of rock mass) 19. An influence of mining on terrain subsidence – a necessity to protect the surface 20. A rockburst threat and a coordination of the mining works 21. A way of venting the planned wall
STAGE II. Introducing a new wall to a scheme of a course of the walls
22. A decrease of an approximate density of a coal bed in the longwall, by more than 20% in relation to the designed volume 23. Emergence of tectonic disturbances (washing out, rock inclusions) causing a necessity of mining ganguein a wall 24. Emergence of the overgrowths of gangue in a bed, total density of which exceeds 30% of the designed bed density 25. Emergence of faults, which, with the applied mining technology, can be surmounted without a necessity to convert the wall 26. Emergence of faults, which, with the applied mining technology, cannot be overcome without converting the wall 27. Emergence of tremors in the area of the planned wall or in the immediate vicinity 28. Emission of methane in quantities exceeding the predicted concentrations, causing a necessity to decrease an intensity of execution of the mining works 29. Emergence of the air temperature in the wall and in the longwall zone workings, exceeding a level of 28°C, which will cause a necessity of the crew's working time reduction 30. Emergence of the rocks fallouts and cave-ins causing technical stoppages of the wall, mine faces in the longwall zone's workings or in the wall cross-cut 31. Emergence of eruption of gases or rocks 32. A necessity to redevelop the workings due to the occurring stresses, swelling of the rocks etc. 33. Lack of an effective possibility of venting the wall 34. Adopted manner of materials transport 35. Adopted manner of ore haulage 36. Adopted longwall equipment 37. Adopted manner of transport to reinforce the wall, depending on the inclinations 38. A necessity to drain the water from the water tank which emerged in the excavations of the wall which is situated higher
STAGE III. Beginning of a wall reinforcement
39. A decrease of an approximate density of a coal bed in the longwall, by more than 20% in relation to the designed volume 40. Emergence of tectonic disturbances (washing out, rock inclusions) causing a necessity of mining gangue in a wall 41. Emergence of the overgrowths of gangue in a bed, total density of which exceeds 30% of the designed bed density 42. Emergence of faults, which, with the applied mining technology, can be surmounted without a necessity to convert the wall 43. Emergence of faults, which, with the applied mining technology, cannot be overcome without converting the wall 44. Emergence of tremors identified in the longwall zone's workings or in the wall cross-cut, or in the immediate vicinity

cont. of table 1

45. Emission of methane in quantities exceeding the predicted concentrations, causing a necessity to decrease an intensity of execution of the mining works in the longwall zone's workings or in the wall cross-cut 46. Emergence of the air temperature in the wall and in the longwall zone workings, exceeding a level of 28°C, which will cause a necessity of the crew's working time reduction in a mine face in the longwall zone's working or in the wall cross-cut 47. Emergence of the rocks fallouts and cave-ins causing technical stoppages of the wall, mine faces in the longwall zone's workings or in the wall cross-cut , which exceed 1 mining shift 48. Emergence of eruption of gases or rocks in the longwall zone's workings or in the wall cross-cut 49. A necessity to redevelop the longwall zone's workings or the wall cross-cut, causing a necessity to delay the wall's reinforcement for a period of 3 days 50. Lack of the essential technical equipment of the longwall zone's workings to reinforce the wall 51. Lack of an extracting machine essential to reinforce the wall on a specified date 52. Lack of powered roof support essential to reinforce the wall on a specified date 53. Lack of a conveyor belt essential to reinforce the wall on a specified date 54. Lack of electrical machines and devices essential to reinforce the wall on a specified date 55. Lack of hydraulic devices essential to reinforce the wall on a specified date 56. Lack of other devices and technical equipment of the longwall zone's workings essential to reinforce the wall on a specified date 57. Lack of a reinforcement and liquidation unit on a specified date 58. Lack of a mining unit on a specified date 59. Lack of electrical-machine services on a specified date 60. A delay of the completion date of a course of a preceding wall
STAGE IV. Mining of a wall
61. Too high extraction plan in relation to the achieved extraction after a start-up period of the wall (after a month) 62. A decrease of an approximate density of a coal bed in the longwall, by more than 20% in relation to the designed volume 63. Emergence of tectonic disturbances (washing out, rock inclusions) causing a necessity of mining gangue in a wall 64. Emergence of the overgrowths of ganguein a bed, total density of which exceeds 30% of the designed bed density 65. Emergence of faults, which, with the applied mining technology, can be surmounted without a necessity to convert the wall 66. Emergence of faults, which, with the applied mining technology, cannot be overcome without converting the wall 67. Emergence of rockbursts in the wall or in immediate vicinity 68. Emission of methane in quantities exceeding the predicted concentrations, causing a necessity to decrease the intensity of mining – decrease of a wall velocity 69. Emergence of a fire in the old workings 70. Emergence of the air temperature in the wall and in the longwall zone workings, exceeding a level of 28°C, which will cause a necessity of the crew's working time reduction or conducting the wall through rescue teams 71. Emergence of the rocks fallouts and cave-ins causing technical stoppages of the longwall, exceeding 1 mining shift 72. Emergence of eruption of gases or rocks in the wall 73. A necessity to redevelop the longwall zone's workings , causing a stoppage of a wall course for a period of 1 extraction shift 74. Failure of an extracting machine, the removal of which requires a wall stoppage for a period longer than 1 mining shift 75. Failure of a wall conveyor, the removal of which requires a wall stoppage for a period longer than 1 mining shift 76. Failure of power roof support, the removal of which requires a wall stoppage for a period longer than 1 mining shift 77. Failure of hauling machines and devices beyond the wall, causing a necessity of stopping the mining works in the wall for a period longer than 1 mining shift.

Source: Own elaboration.

3. A core of the method of risk management of a longwall

The method of risk management of a longwall comprises of 5 stages, which include: 1) risk factors identification, 2) risk measurement, 3) risk assessment, 4) mapping out a response strategy to a risk, 5) taking a decision on activating and mining of a longwall. In the method, there are used the devices applied in the risk management of the projects, particularly: a checklist, a risk map, a risk diagram and a matrix of responding to a risk[3].

Stage 1. Risk factors identification consists in indicating the risk factors of a given longwall (from the list of factors named in point 2, in table 1) and then describing them with use of a checklist (table 2). A core of a description of the risk factors is to name an effect and a chance (probability) of their occurrence – on the basis of an accepted scale (tables 3 and 4). It is assumed that 4 checklists should be prepared for the purpose of identifying the risk factors on 4 stages of activating and mining of a longwall, i.e..: I – designing of the mining in a bed; II – introducing a new wall to a scheme of a course of the walls; III – taking a decision on the beginning of a wall reinforcement; IV – mining of a wall.

It was suggested, that at least 3 mine's workers should take part in the respective stages. On stage I, there should be the workers of the production preparation, mining and measurement–geological divisions. On stage II - production preparation, mining and ventilation divisions, and on the stages III and IV - production preparation, mining and energy-machine divisions.

Table 2

A model checklist of a risk of a longwall

A name of the mine	A name of an ore zone		A bed number		A wall number		An elaboration date	
A name of a stage of activating or conducting a longwall								
No. and a name of a factor	Description 1		Description …		Description n		RISK DESCRIPTION	
	Effect	Chance	Effect	Chance	Effect	Chance	An average effect	An average chance
1. … 2. … N. …								

Source: Own elaboration.

[3] PRINCE2TM – Skuteczne Zarządzanie Projektami. Crown Copyright 2009. Drugie wydanie polskie. Crown Copyright, 2010, s. 81-92; A Guide to the PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOK®Guide) - Fifth Edition. PMI. Wydanie polskie. Management Training & Development Center, Warszawa 2013, s. 301-345.

Table 3

A scale of an effect of occurrence of the risk factors of a longwall

An effect of occurrence of a risk factor	Scale
A little effect An occurrence of a factor may cause a little disruptions in achieving the planned extraction and a relatively small financial loss for the mine. The factor has a little influence on the decrease of efficiency of conducting mining, and the effects of an event included in the risk could be easily removed.	**0-2**
An average effect An occurrence of a factor may cause slight (over 3-days) delays of a date of activating the wall and in achieving the planned extraction (over 10%) in a period up to a few days since the wall's activation. The factor could be the reason of a relatively small financial loss for the mine and it could have an influence on a slight decrease of efficiency of conducting mining, and the effects of an event included in the risk should not be a problem.	**3-4**
A big effect An occurrence of a factor poses a serious threat to a date of the wall's activation (from 3 days to 2 weeks) and to achieving extraction from the wall below the planned level (20%) within two weeks from its activation. The factor could be the reason of a significant financial loss for the mine and have a negative influence on the efficiency of conducting mining, and an occurrence of an event included in the risk could involve a difficult process of restoring the previous condition.	**5-6**
A very big effect An occurrence of a factor poses a very serious threat of a significant deferment (from 2 weeks to 1 month) of a date o the wall's activation and achieving extraction below the planned level (30%) in the period of 1 month from its activation. The factor could be the reason of a very significant financial loss for the mine and have a very negative influence on the efficiency of conducting mining and the quality of executed tasks, and an occurrence of an event included in the risk could involve a long-lasting and difficult process of restoring the previous condition.	**7-8**
A disastrous effect An occurrence of a factor poses a very serious threat, which can affect a resignation from the wall's activation or a significant postponement of a date (over 1 month) of the wall's activation and achieving the planned extraction (over 30%) in a period of over 2 weeks from its activation. The factor could be the reason of a very significant financial loss for the mine and have a very negative influence on the efficiency of conducting mining and the quality of executed tasks. An occurrence of an event included in the risk could involve a long-lasting and difficult process of restoring the previous condition. Restoring the previous condition might be as well impossible.	**9-10**

Source: Own elaboration.

Table 4

A scale of a chance of occurrence of the risk factors of a longwall

A chance of occurrence of the risk factor	Scale
A very little chance A risk factor will occur with a very little probability (from 0 to 19% of chances of occurring within a year).	**0-2**
A little chance A risk factor will occur with an approximately little probability (between 20% and 39% of chances of occurring within a year).	**3-4**
An average chance A risk factor will occur with an average probability (between 40% and 59% of chances of occurring within a year).	**5-6**

cont. of table 4

A big chance A risk factor will occur with a big probability (between 60% and 79% of chances of occurring within a year).	**7-8**
A very big chance A risk factor will occur with a very big probability (over 80% of chances of occurring within a year).	**9-10**

Source: Own elaboration.

Stage 2. Risk measurement consists in indicating a value of a risk index of a longwall, with use of a risk map (fig. 1). On the map, the values of a vertical axis correspond to the values of the scale of a chance, and the values of a horizontal axis – to the values of a scale of an effect of occurrence of a given risk factor. The risk index is a product of arithmetic means of the values of effect and chance, which were indicated on a checklist for the risk factors.

A scale of a chance	**Very big**	**10**	10	20	30	40	50	60	70	80	90	100
		9	9	18	27	36	45	54	63	72	81	90
	Big	**8**	8	16	24	32	40	48	56	64	72	80
		7	7	14	21	28	35	42	49	56	63	70
	Average	**6**	6	12	18	24	30	36	42	48	54	60
		5	5	10	15	20	25	30	35	40	45	50
	Low	**4**	4	8	12	16	20	24	28	32	36	40
		3	3	6	9	12	15	18	21	24	27	30
	Very low	**2**	2	4	6	8	10	12	14	16	18	20
		1	1	2	3	4	5	6	7	8	9	10
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
			Little		**Average**		**Big**		**Very big**		**Disastrous**	
			Effect scale									

Fig. 1. A map of the risk of a longwall
Rys. 1. Rozkład poziomu ryzyka ściany wydobywczej
Source: Own elaboration.

Stage 3. Risk assessment is carried out on the basis of calculated values of the risk index. In particular, it was assumed that the index values:

- 0 ÷ 10 (marked in white on the risk map) mean a very little risk of activating and mining of a longwall;
- 10 ÷ 20 (marked in light grey on the risk map) mean a little risk of activating and mining of a longwall;
- 20 ÷ 50 (marked in grey on the risk map) mean an average risk of activating and mining of a longwall;
- 50 ÷ 80 (marked in dark grey on the risk map) mean a big risk of activating and mining of a longwall;
- 80 ÷ 100 (marked in black on the risk map) mean a very big risk of activating and mining of a longwall.

Stage 4. Mapping out a response strategy to a risk should concentrate on the factors which have influence on an average, and in particular a big and a very big risk of the wall. For the purpose of indicating these factors, a diagram of the risk of a longwall can be used (fig. 2). It is drawn up in a form of a bar chart which shows:

- on a vertical axis, five specified levels of the risk of a wall,
- on a horizontal axis, the risk factors of a wall, marked in a form of bars of height corresponding to a value of the risk index of a wall.

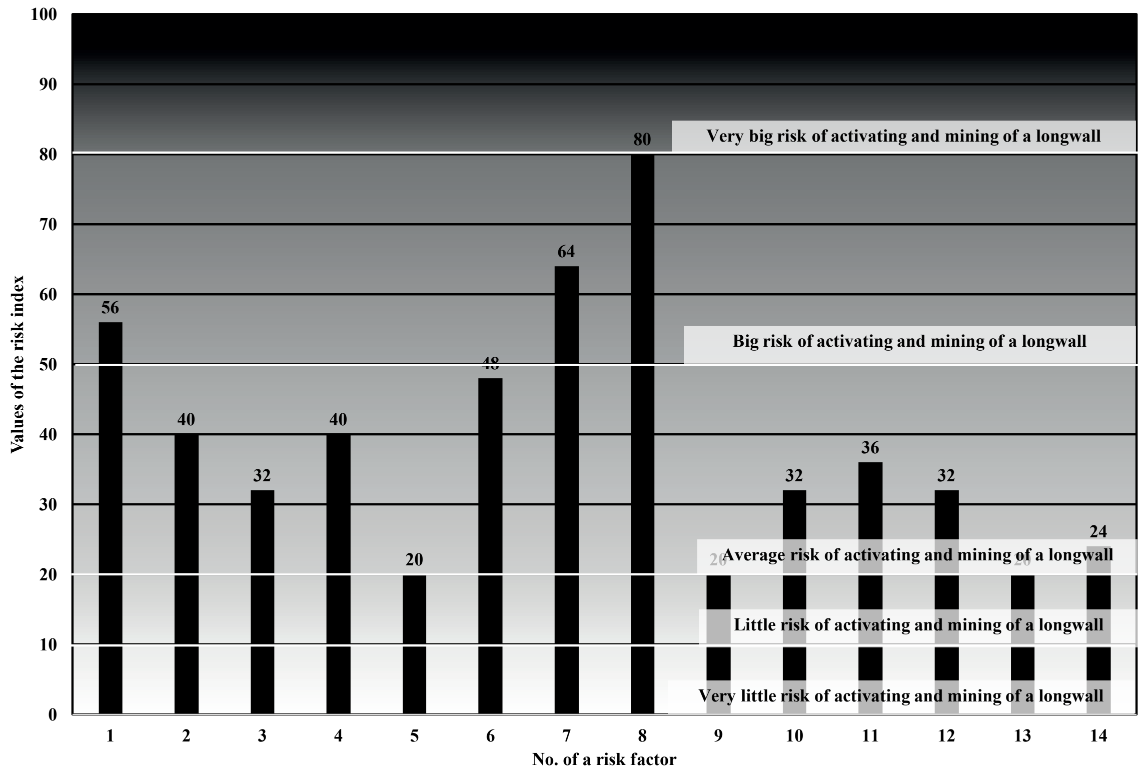

Fig. 2. An exemplary diagram of the risk of a longwall
Rys. 2. Przykładowy diagram ryzyka ściany wydobywczej
Source: Own elaboration.

In was suggested that for a description of the response strategy to a risk on each of the four stages of activating and mining of a longwall, there should be used a so-called matrix of responding to the risk factors (table 5).

Table 5

A matrix of responding to the risk factors of a longwall

A name of the mine		A name of an ore zone	A bed number		A wall number		An elaboration date	
A name of a stage of activating or conducting a longwall								
An assessment of an original risk	A number and a name of a risk factor	A response strategy to a risk	A person responsible for implementation of the strategy	A deadline of the strategy implementation	An adequacy of the strategy	An effectiveness of the strategy	An index of a residual risk	An acceptance of the residual risk YES/NO
Very big								
Big								
Average								

Additional arrangements:
……

Elaborated by:
Name and surname

Approved by:
Name and surname

Source: Own elaboration.

In the matrix, there should be indicated the people responsible for implementation of appropriate activities in regard to a risk in the specified time horizon. These people should assess the so-called residual risk which will linger after executing all possible activities, leading up to minimizing the effects and probability of occurrence of the risk factors. The residual risk should be assessed in relation to an adequacy of the suggested response strategy to the identified risk factors and to the effectiveness of the suggested strategy in relation to the existing risk level. Five levels of adequacy of the suggested response strategy to the identified risk and three levels of effectiveness were adopted (table 6). Naming them allows us to indicate a rate of the residual risk which may range from 0,1 to 1. The residual risk is a product of the risk index (an original one – before the strategy's implementation) and a rate of the residual risk.

Table 6

Indicating a value of a rate of the residual risk

Adequacy of the suggested response strategy to the existing risk (original)	Effectiveness of the suggested response strategy to the existing risk (original)		
	Level 1 High effectiveness	**Level 2** Average effectiveness	**Level 3** Low effectiveness
Level 1 The accepted response strategy to a risk includes all possible activities for the purpose of decreasing a wall risk level or its total elimination. There is no possibility to apply other activities.	**0,1**	**0,3**	**0,6**
Level 2 The accepted response strategy to a risk includes most of the essential activities for the purpose of decreasing a risk level or its total elimination. There are restricted possibilities to apply other activities to decrease the risk.	**0,2**	**0,4**	**0,7**
Level 3 The accepted response strategy to a risk includes some of the essential activities for the purpose of decreasing a risk level or its total elimination. There are relatively lots of possibilities to apply other activities to decrease the risk.	**0,4**	**0,5**	**0,8**
Level 4 The accepted response strategy to a risk includes few activities for the purpose of decreasing a risk. There are lots of possibilities to apply other activities to decrease the risk level.	**0,5**	**0,7**	**0,9**
Level 5 Lack of an accepted response strategy to a risk. There is a very big range of possibilities to apply other activities to decrease the risk level.	**1,0**	**1,0**	**1,0**

Source: Own elaboration.

Stage 5. Taking a decision on activating and mining of a longwall should be based on the residual risk assessment. In case of sufficient adequacy and effectiveness of the elaborated strategy, the consequence of which will be a very low or a low risk, a decision can be taken on activating and mining of a given longwall, which is equivalent to the execution of the specified activities in relation to the risk. However, in a situation when the measures taken within the elaborated strategy are not sufficiently effective or adequate and having implemented them a level of the residual risk will stay average, big or very big, a negative decision should be taken. In such a situation this could mean:

- on stages I and II – a resignation from mining of the designed longwall,
- on stage III – a significant deferment of a date of the wall's activation in relation to a scheme of a course of the walls,
- on stage IV – stoppage of the mining of a wall.

Conclusions

The presented method of risk management of a longwall was elaborated for the purpose of supporting the production planning process in the coal mines. The devices of risk management suggested within this method are simple solutions, which allow identification, measurement and assessment of the risk, as well as mapping out a response strategy to a risk and taking relevant decisions regarding activating and mining of a longwall, depending on the assessment of the residual risk level. The accepted indexes of risk assessment are of subjective character but they can be applied to the conditions of a mine in which the decisions are taken.

The elaborated method was verified in five Silesian coal mines. Currently, to support this method in practice, a computer program is being developed. Its basic aim is to reduce the execution time of respective stages and to eliminate the errors which might occur during traditional ("manual") data compiling.

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Omówienie

Przedstawiona w artykule metoda zarządzania ryzykiem ściany wydobywczej została opracowana dla wspomagania procesu planowania produkcji w kopalniach węgla kamiennego. Zaproponowane w ramach metody narzędzia zarządzania ryzykiem stanowią proste rozwiązania, które pozwalają na identyfikację, pomiar i ocenę ryzyka, a także opracowanie strategii reagowania na nie oraz podejmowanie odpowiednich decyzji, dotyczących uruchomiania i eksploatacji ściany wydobywczej, w zależności od oceny poziomu ryzyka rezydualnego. Przyjęte wskaźniki oceny ryzyka mają wprawdzie subiektywny charakter, lecz można je dostosować do warunków kopalni, w której są podejmowane decyzje.

Opracowana metoda została zweryfikowana w pięciu kopalniach węgla kamiennego Górnośląskiego Zagłębia Węglowego. Obecnie, dla wspomagania tej metody, w praktyce opracowywany jest program komputerowy. Jego podstawowym celem jest ograniczenie czasu realizacji poszczególnych etapów i wyeliminowanie błędów, które mogą powstać podczas tradycyjnego („ręcznego”) opracowania danych.