

A LIQUIDATION OF THE MINE IN SRK S.A. IN A PROGRESSIVE APPROACH

Janusz SMOLIŁO¹, Andrzej CHMIELA^{2*}

¹ Spółka Restrukturyzacji Kopalń S.A., Bytom; jsmolilo@srk.com.pl, ORCID: 0000-0003-4987-2881

² Spółka Restrukturyzacji Kopalń S.A., Bytom; achmiela@srk.com.pl, ORCID: 0000-0002-0833-0923

* Correspondence author

Purpose: The scientific research was aimed to identify the procedure of actions in the company which deals with the liquidation of the mines. The procedure and conclusions which are presented will be the base to ensure effectiveness and efficiency of the processes of the liquidation.

Design/methodology/approach: To create a model of the process management systems in SRK S.A. three stages of research were achieved. The available literature on the management processes was analyzed and compared with personal experience of the mine liquidation. Interviews were conducted with the Branch Management of SRK S.A. The maps of the process of the liquidation were prepared and the areas and problems of the research were shown.

Findings: The respondents wanted to have prepared the process flow maps, that will facilitate the conduct of current and possible future liquidation processes in terms of financial efficiency.

Research limitations/implications: An analysis and solution of those problems will allow to improve the efficiency and accuracy of the conducted liquidation process.

Practical implications: The process of the liquidation of the mines is complex and costly. The rationalization and the minimization of the costs is the base to ensure effectiveness and efficiency of the processes of the liquidation.

Social implications: The process of the liquidation of the mining plant requires a number of interrelated economic, environmental and legal factors. A lack of indicated priorities can repeatedly led to competency, ambition and organizational conflicts.

Originality/value: The article presents the maps, figures, tables and surveys which introduce the process of the liquidation of the mines.

Keywords: process management, restructuring of mining enterprises, liquidation of a hard coal mine.

Category of the paper: research article.

1. Introduction

The areas of the Upper Silesian and Lower Silesian Coal Basin were among the most industrialized regions in the country and Europe with rich mineral deposits. The exploitation of the natural resources there, and in a particular coal mining since the turn of the 18th and 19th centuries, has led to a drastic disturbance of the balance of the natural environment. The caving in of ground surfaces above mining sites and flooding of large areas, contamination of surface waters and drainage of aquifers have been the results of the impact of mining on the environment. The consequences can be felt not only during the active operations, but also many years later after its completion. The mine liquidation is the last stage of the mining activity, usually as a result of the depletion of the exploited deposit or unprofitability of mining. The investment process leading to the mine liquidation is complex and costly. Important conditions influencing the conditions of the implementation process of liquidation in Polish mines are: the age of mines, a multi-deck exploitation, the depth of exploitation, an occurrence of numerous often associated natural hazards, the urbanization and a rich infrastructure on the surface of mining areas. In the old coal basins of Europe, with comparable or even easier conditions, hard coal mining has already been abandoned or is no longer able to function without state aid (Grmela et al., 2017; Harat et al., 2017).

Since the beginning of the 1990s the Polish hard coal mining industry has been implementing restructuring activities aimed at adapting the industry to the needs and conditions of the market economy, which were based on government programs mainly financed from the budget. As a result of the restructuring processes, the number of active hard coal mines decreased from 70 in 1990 to 20 today, and the number of employees has decreased from almost 400,000 people to about 70,000 people (Korski, Korski, 2015; Marek, 2006; Paszcza, 2010).

The liquidation activities are carried out by Spółka Restrukturyzacji Kopalń S.A., established in 2000. The company's tasks include the liquidation and securing of mining excavation sites, the liquidation of buildings, machinery and equipment, security works and the implementation of measures to prevent hazards resulting from the liquidation of the mining plants. These tasks are currently carried out by 8 Branches of SRK S.A. (www.srk.com.pl). Other responsibilities of one of the branches of SRK S.A. include the management of industrial property after the liquidated mines in conjunction with the Property Management Department. Its Housing Resource Administration is also responsible for the management of non-industrial assets (apartments, garages, commercial premises, etc.). As part of the securing of neighboring mines against flooding, the Company pumps water from sites of previously closed mines.

On the basis of European Union approval, the Polish government obtained permission to finance the liquidation from the state budget until the end of 2023. The value of the subsidy will amount to approximately 5 billion PLN. Despite such significant expenditures, the implementation of the mine liquidation processes has not been the subject of scientific research yet aimed at defining the principles of rationalizing and minimizing the costs incurred.

2. Legal and economic aspects of the mine liquidation process

The economic activity of extracting minerals has led to unfavourable environmental changes that may occur both at the stage of exploitation and many years after its completion (Duda 2018, Wójcik 2018). Legal regulations correspond to the complexity of the environmental consequences of mining activities. The closure of the mines is regulated in Chapter 5 of the Act of June 9, 2011, Geological and Mining Law. According to the Art. 129 of this Act, in the event of liquidation of a mining plant, in whole or in part, the entrepreneur is obliged to:

- secure or liquidate mining excavations as well as equipment, installations and facilities of the mining plant,
- Secure the unused part of the mineral deposit,
- Secure the adjacent mineral deposits,
- Take necessary measures to protect the excavations of neighbouring mining plants,
- Take necessary measures to protect the environment and reclaim the land after mining activities.

For many years, the costs of liquidation of mining plants were covered by the state budget. In 1998, the amendment to the 1994 Geological and Mining Law, which was then in force, obliged mines to establish liquidation funds as of 1 January 2000. Enterprises with a license for underground and borehole mining undertook to establish a liquidation fund in the amount of no less than 3% of depreciation charges on fixed assets of the mining plant. The collected funds may be used only to cover the costs of decommissioning the mining plant (Paszczka, 2010; Turek, 2013).

3. Research problems

In a dynamic and competitive economic world, a company's success requires modern management to utilise methods which lead to the improvement and effectiveness in the conduct of business activity (Przybyła, Chmiela, 2007). The concept of process management has recently become one of the dominant and developing directions of economic theory and practice (Bijańska, Wodarski, 2018, 2020; Bitkowska, 2013; Brilman, 2002; Brzychczy et al., 2018; Dźwigoł, 2007; Grajewski, 2012; Nowosielski, 2011; Rother, Shook, 2009; Skrzypek, Hofman, 2010).

In the hard coal mining industry, no comprehensive solutions tailored to the specifics of the industry have been developed. A developed solution for solving issues related to the efficiency of the mining process or preparatory works (Jonek-Kowalska, 2013, Przybyła, Chmiela, 2002,

2007; Turek, 2013; Turek, Jonek-Kowalska, 2013). In the case of liquidation of mines, no scientific research has been conducted so far to improve efficiency. The available literature concerns only general issues related to these problems (Grajewski, 2012; Riesgo et al., 1997, 2000, 2001, 2003).

The lack of available literature in this particular field has exacerbated and complicated the research process. These studies will be aimed at developing the procedures for implementing a management process. The publication tries to identify the problem and research areas that require further analysis, present procedures and conclusions displaying information for the analysis of costs associated with implementation of procedures in complex economic conditions (Bitkowska, 2013; Brilman, 2002; Brzywczy et al., 2018; Dźwigoł, 2007; Grajewski, 2012; Nowosielski, 2011; Rother, Shook, 2009; Skrzypek, Hofman, 2010).

4. Research methods

To create a model of process management systems in SRK S.A. it was necessary to identify the areas and research problems that needed to be solved. The Objective was achieved in three steps (Table 1). The research plan was carried out on the basis of the actual data collected on the current mine closure processes.

Table 1.

Methods and results of their use in individual research stages

Research stage	Research methods	Results of the use of research methods
I	- Study of literature - Analysis - Synthesis	- Adaptation of basic concepts to the specificity of SRK S.A. - The current state of process management in SRK S.A. - Development of a questionnaire for the interview.
II	- Face-to-face interview - Panel studies - Analysis - Synthesis	- Indication of basic research areas and problems. - Development of an initial model of liquidation processes.
III	- Direct interview - Panel studies - Analysis - Synthesis	- Building a map of the processes taking place in SRK S.A. - Indication of problem solving and problem solving.

Source: An own study.

In stage I, the available literature on the management processes was analysed and compared with personal experience of the mine liquidation. The author's considerations focused on adapting and organising scientific terms with their practical application. It was considered which elements would allow the correct adaptation of the process management concept to the specificity of SRK S.A. The results of the analysis made it possible to prepare an interview which is used in the second stage.

In the second stage, interviews were conducted with individuals directly managing the activities of the Company and its Branches. The interviews allowed for the identification of areas and research problems necessary to solve for the adaptation of the process management system to the specificity of SRK S.A. The prepared interview questionnaire is presented in the Table 2. Based on conversations and own experience, preliminary models of the progression of processes taking place in the closed mines at SRK S.A. were prepared. Initial models were used in the third stage of the research.

In the third stage, the preliminary process maps were consulted and corrected in order to obtain the final version of the process map compatible with all Branches of SRK S.A. During this stage, questions were asked about the nature of the process, technical problems in the implementation of these processes, the correctness of their progression and suggestions for possible changes in the liquidation practice. The process was carried out in two stages, as shown in Fig. 1. The preliminary process model prepared in the second stage was consulted with people closely related to the mine closure and changes were applied on an ongoing basis. After all experts had analyzed the working process model and all changes had been made, the process map was re-presented to the same experts for approval (panel studies). After approval by all experts, the model became the final model of the process. Following the experts' suggestions, the maps of component processes were prepared in a similar way.

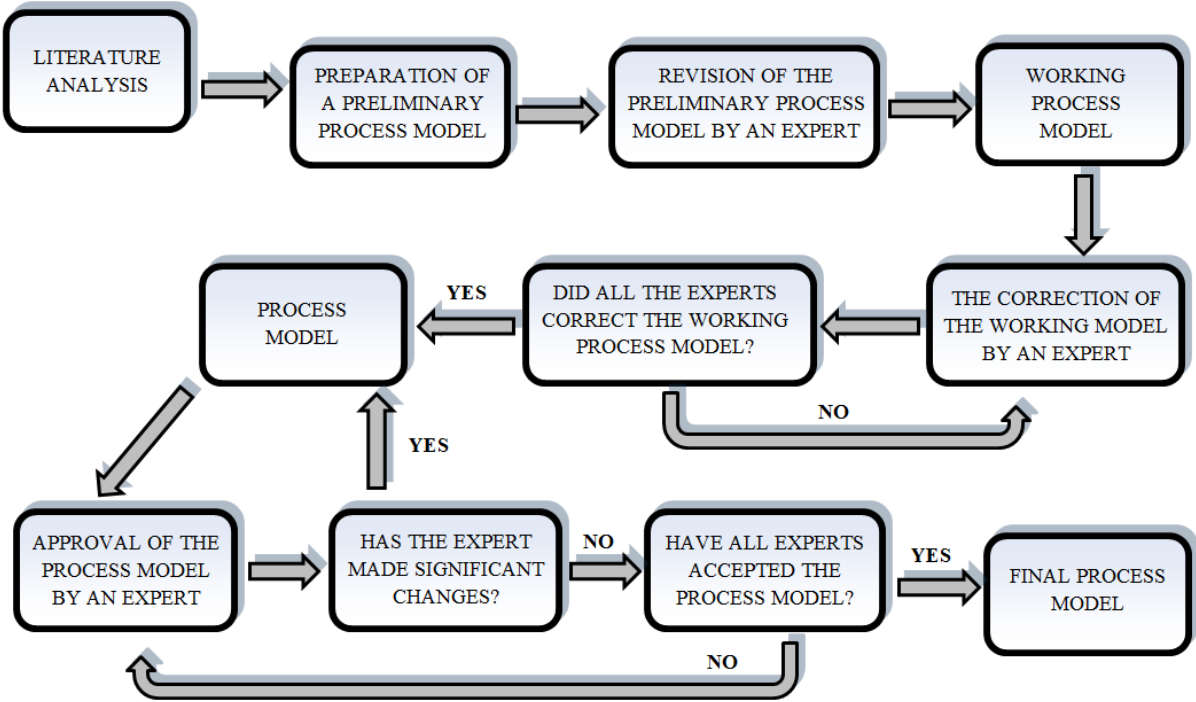


Figure 1. A map of the research process (panel study). Source: an own study.

5. Findings

In the first stage of the research, on the basis of a literature study on process management, the concept of the terms "process", "process approach" and "process management" was systematized. The authors agreed with the definitions proposed for mining enterprises (Bijańska, Wodarski, 2018, 2020). In SRK S.A:

A "process" is a sequence of ordered, reciprocal works with each other, carried out sequentially to produce the final production, which is combined with other processes, remaining with each other in specific dependencies and relationships necessary for the goal of creating value.

The "process approach" is an ideological layer or a philosophy of company management that places processes at the centre of attention of its management and employees.

"Process management" is a comprehensive management concept aimed at satisfying customer needs as fully as possible through the improvement and efficiency of value management.

After systematizing the top positions and persistent attempts to steer along the way, an intelligence survey was prepared. Questions included in the form, as well as related problems, to get to know the current state and identify areas and research problems related to the management of the processes, requiring analysis and development.

In the second stage interviews were held with seventeen participants involved in the liquidation. The respondents were Branch Directors, Chief Engineers and Main Engineers. During the course, the field for comments was completed. Synthetic authors of the answers provided are presented in Table 2.

Table 2.

A set of survey questions with an original summary of the respondent's answers

	Question	Answer
1.	Is there an awareness of the actions in processes in SRK S.A?	Most employees function within unspecified processes.
2.	Is there an awareness of the interconnection between processes in SRK S.A.?	There is unsystematic knowledge about the interconnection of processes.
3.	Are the processes identified within SRK S.A?	Some of the tasks were identified and named, but the main process is common knowledge.
4.	Is there a knowledge of division into primary and auxiliary processes in SRK S.A?	There is an unsystematic knowledge about which process is primary and which is ancillary.
5.	Is there a mapping of the liquidation processes in SRK S.A?	Processes are presented as regulations or procedures. Respondents report an urgent need for a process map.
6.	Is the organizational structure within SRK S.A. managed in a way to allow it to manage processes?	The organizational structure of the Branches is not adapted to process management, and to allow functional teams to implement the process.
7.	Are processes related to strategic goals in SRK S.A. ?	Employees are aware that their actions lead to the achievement of the Company's goals.
8.	Does SRK S.A. evaluate the process control?	Due to the long implementation time of the processes, improvement is usually not sought.

Cont. table 2.

9.	Do employees have an influence on the correction of processes? Workers sometimes have a choice.
10.	Does SRK SA. have application teams for implementing individual processes? Assessment teams for individual processes are established.
11.	Are SRK S.A. employees team-oriented? Employees participate in a teamwork.
12.	Do SRK S.A. employees know the concept of the process management? Only the top management knows the principles of the process management.
13.	Do SRK S.A. employees have knowledge about the implementation of processes? An intelligible message was prepared on the implementation of the individual processes.
14.	Are SRK S.A. employees motivated to share their experience? There is a lack of motivation to share knowledge, but in some Departments the Master-Apprentice binary system works well.
15.	Is there an incentive system connected to completions? Due to the long implementation time, there is no incentive system in place which is connected to final results of the processes.

Source: an own study.

During the research, the respondents noted a certain difficulty in using the term "process", which is related to a cyclical phenomenon. For most employees, the cyclical nature of activities in SRK S.A. is imperceptible. The vast majority of the Company's staff are former employees of active mines and their experience is associated with short cycles, e.g. the mining cycle or the excavation cycle, which took place several times in a shift. The mine liquidation period, depending, among other things, on its size ranges from 2 to 8 years. Employees in SRK S.A. (mainly due to the age) usually only work on one liquidation cycle and each of their activities, from their point of view, is only performed once. The cyclicity is observed from the level of the entire Company. From this perspective, the repeatability of certain activities is visible, and although each of the mines is different, certain elements that appear constantly can be distinguished. Only from this point of view, in the case of the liquidation of mines, one can speak of a cyclical nature and treat these activities as repetitive long-term processes.

The respondents pointed to the need for the preparation of process flow maps, that will facilitate the conduct of current and possible future liquidation processes in terms of financial efficiency. The respondents found that the classification of processes into basic, auxiliary and accompanying processes was particularly important and urgent to develop, as the failure to indicate priorities repeatedly led to competency, ambition and organisational conflicts, which translates into the Company's financial result.

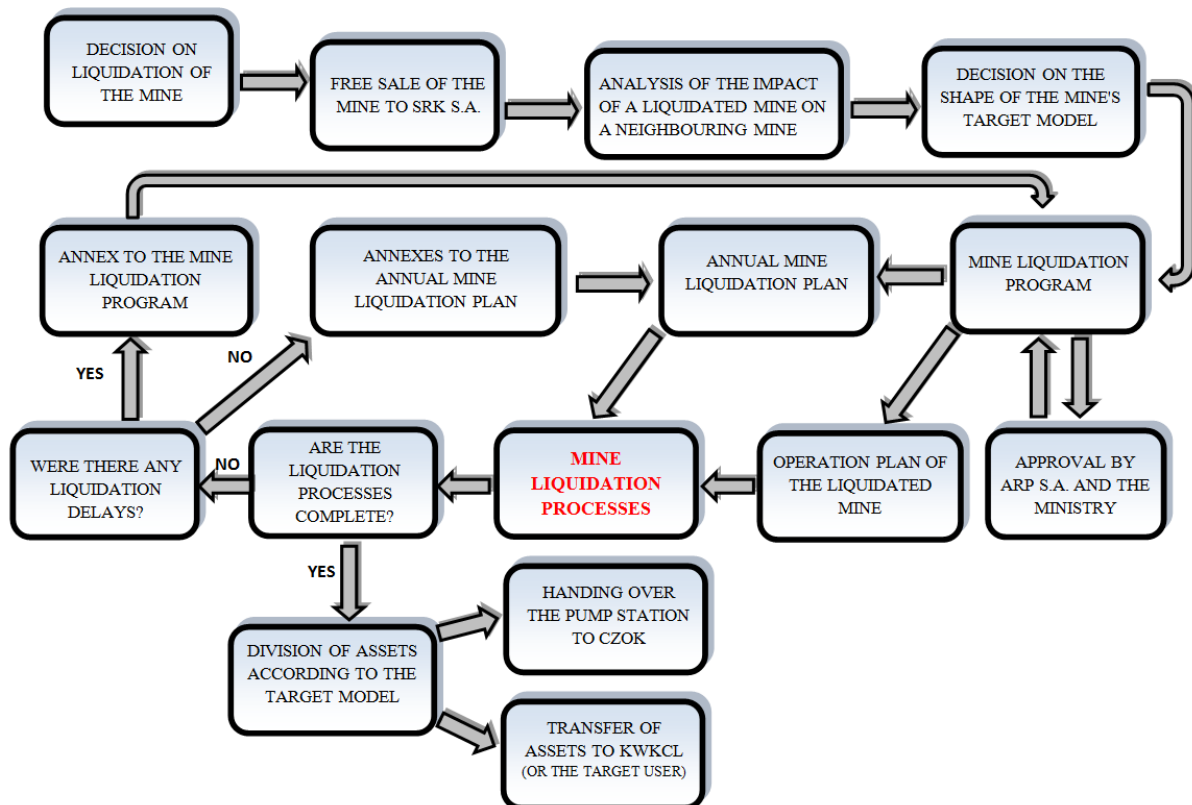


Figure 2. A map of the mine liquidation processes at SRK S.A. Source: an own study.

At this stage of research, research areas and problems were identified:

developing guidelines for changing the structure of the Branches to one in line with the "process approach."

- definition of the process mapping standards and possible quick preparation of process maps,
- urgent development of the existing system of classification processes for basic, auxiliary and accompanying processes,
- indication of the main factors influencing the course of processes, and thus assigning their measures to the processes,
- developing guidelines for building an employee knowledge management system,
- developing guidelines for building an incentive system.

In the third stage of research, in accordance with the conclusions of stage II, attempts were made to formalize the course of the processes taking place during the mine's liquidation. The research, just like in stage II, was based on interviews with experts, with the difference that they were presented with a map of the process for correction. The experts changed their opinions significantly. During the analysis of the process maps, a "loose" conversation was conducted on the course of the processes and possible conclusions for changing the current state, with experts ranging from the Higher Supervisory Board to the Company's President.

Everyone agreed that in the course of the mine liquidation the core of the basic processes, will be a group of processes in Figure 2 named as "Mine liquidation processes" (written in red). This group of processes does not run independently. Each basic process is accompanied by auxiliary or accompanying processes, and in this perspective all other processes should be understood as such. In accordance with the procedure shown in Figure 1. The authors developed a map of the mine liquidation processes shown in Figure 2.

The mine liquidation processes are broad terms, it would be difficult to treat them as one process. According to the principles of process mapping (Rother, Shook, 2009; Skrzypek, Hofman, 2010) and the practice used in SRK S.A. mine liquidation processes are divided into 10 smaller processes (referred to as "schedules" in SRK S.A. Each of the processes (schedules) presented in Table 3 and Figure 3 includes specific operations and activities. At this level of mapping detail, the inter dependencies between individual processes are not visible, and processes 3 to 10 can temporarily be treated as accompanying processes, but their operation results from processes 1 and 2.

The respondents unanimously stated that the liquidation of a mine usually follows two variants. These variants are related to the construction of the target mine model. Due to the protection of the neighboring mining plants, the mine can be completely closed (Fig. 4) or with the pumping station (Fig. 5). The liquidation process is slightly different in each of these cases. Figures 4 and 5 use a different process presentation system. An unscaled horizontal timeline has been added to improve readability and illustrate the mutual overlapping of the processes over time.

In the first case, the liquidation process ends with the transfer of the property remaining after the liquidation to the SRK SA Department. Coal Mines in Total Liquidation or the eventual end user. The entire underground infrastructure (excavations and shafts) is being liquidated. Processes 1 and 2 can take place at the same time, but the basic process for the entire liquidation is Liquidation and protection of corridor workings (Process 1). Upon completion of Process 1, Process 2 liquidation and securing of shafts and shafts becomes the primary process. In this model the process of liquidation workings (Process 1), and the process of securing the neighboring mines (Process 3) must be completed before the completion of the shaft liquidation process (Process 2). The land reclamation process (Process 5), may begin only after the mine infrastructure liquidation (Process 4) and maintenance of the facilities to be liquidated (Process 6) are completed. The remaining processes (Process 7, 8, 9 and 10), are carried out throughout the mine liquidation period.

In the event of liquidation and leaving the pumping station, the liquidation ends with the transfer of the study results after, the liquidation to the Department of Coal Mines. Coal Mines in full liquidation, the prepared pumping station to the Central Mine De-watering Plant of the SRK SA Division. A process known as liquidation, and the process of corridors (Process 1). In this case, the process of securing the neighboring mines (Process 3) must continue until the end of the mine closure. Liquidation of shafts (Process 2) may start from the closure of the pits

(Process 1) and may end later, because the liquidation of pits may lead to the shafts remaining open for the pumping station service to continue for the duration, even until the end of the mine closure. The experience as in the first case of the land reclamation process (Process 5) can only start after the mine liquidation process has been repaired (Process 4) and the service facilities to be liquidated (Process 6), and the remaining processes (Process 7, 8, 9 and 10) are also take place throughout the entire period of the mine's liquidation.

Table 3.

The mine liquidation processes in SRK S.A.

1.	Liquidation and securing of excavation gates
2.	Liquidation and securing of shafts and pits
3.	Protection of neighboring mines against water, gas and fire hazards
4.	Liquidation of the mine's infrastructure
5.	Land reclamation
6.	Maintaining the facilities for liquidation in sequence ensuring safe liquidation of the mining plant
7.	Carrying out security works and measures to prevent hazards in connection with the liquidated mining plant
8.	Development of the required projects, documentation, opinions, expertises and analyses related to the closure of the mine
9.	Repair of damage caused by mining plant operations
10.	General management of the tasks performed during the mine closure

Source: data from SRKS.A.

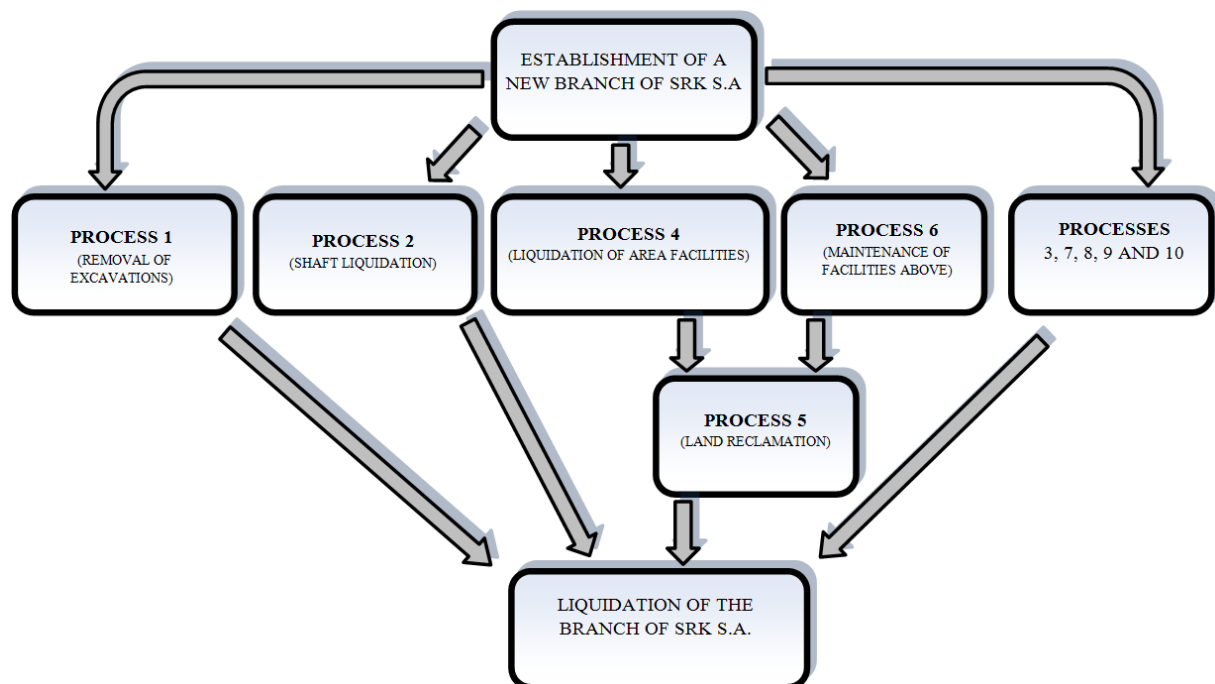


Figure 3. A map of the mine liquidation processes in SRK S.A. Source: an own study.



Figure 4. A schedule of the processes of complete mine liquidation in SRK S.A. Source: an own study.



Figure 5. A schedule of the mine liquidation processes in SRK S.A. with further use of the pumping station. Source: an own study.

During the process mapping, the experts asked for the mapping to be refined so that it was possible to formalize the component processes of the mine liquidation. At this stage of the research, a map of the process of the free disposal of the mine to SRKS.A. (Fig. 7), the map of the process of developing the target model of the liquidated mine (Fig. 8) and the map of the preparation of the mine liquidation program (Fig. 9). These processes are carried out within the organizational structures of SRK SA. Experts (the vast majority of whom had previously taken

part in making such a decision) requested the authors, for formal reasons, to also prepare a map of the decision-making process for the mine to be liquidated (Fig. 6), although this process is not carried out within the framework of the Company and is an external decision, but it is nevertheless an integral part of the activities carried out in the SRK S.A. At this stage of operations, it was considered that the basic process is the deposit exploitation process.

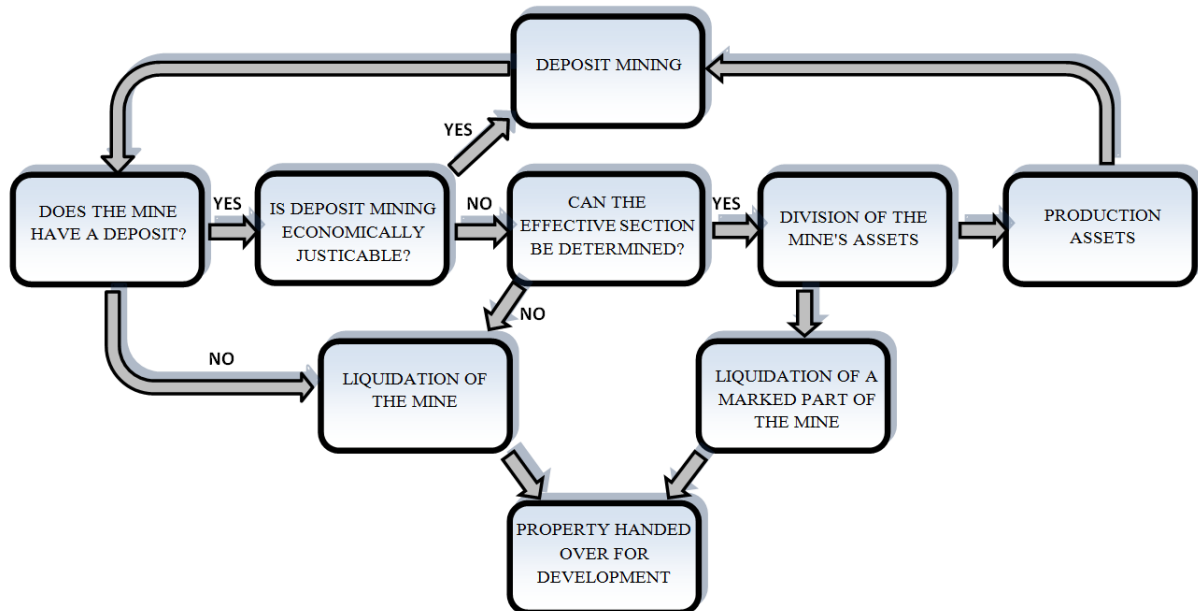


Figure 6. A map of the decision-making process to designate the mine for liquidation. Source: an own study.

Another process carried out outside the structures of the Company is not the sale of the mine or its designated part to SRKS.A. (Fig. 7). It was recognized that the handover process is the division of property transferred for development to individual SRK S.A. Branches.

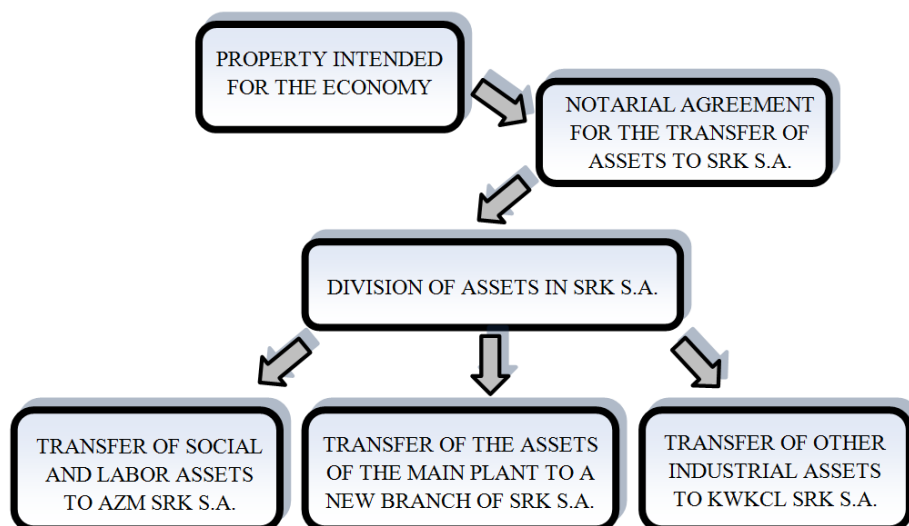


Figure 7. A map of the process of free sale of the mine to SRK S.A. Source: an own study.

Two subsequent processes, the development of the target model of the liquidated mine (Fig. 8) and the preparation of the mine liquidation program (Fig. 9), according to experts, were the processes where the most mistakes were made. These two processes, if carried out correctly, can bring significant financial and non-financial savings for the Company. Due to the lack of procedures, guidelines, experiences or literature on the subject, the decisions taken in the past, then right, often turned out to be wrong in retrospect. When verifying the model maps of these processes, the experts stated that in the case of making decisions on the target model of a mine, the basic process is to prepare this model depending on the water hazards, and decisions on prevention of other hazards must result from water hazards prevention. Figure 8 shows a map of the process of building the target model of the mine, however, experts suggested that the mapping should be refined and a map of this process should be presented with a focus on water hazards.

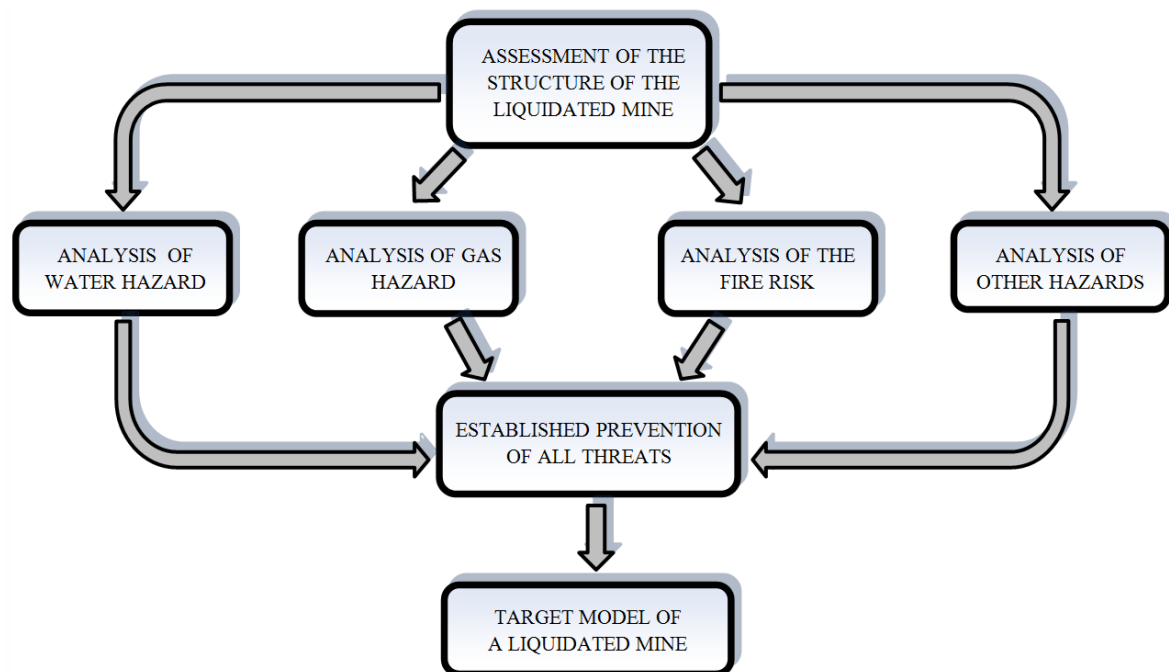


Figure 8. A map of the process of developing the target model of the liquidated mine Source: an own study.

In the map of the mine liquidation program preparation process map (Fig. 9), the experts recognized the liquidation schedule prepared by the mining and ventilation department as the basic process. As in the previous case, it was suggested to lower the mapping level and to show the dependencies and organizational conditions in the process of preparing the liquidation program, so that the division liquidation schedules follow the mining division liquidation schedule. The mining and ventilation department, when developing a schedule for the liquidation of underground facilities and related surface facilities, consults with the power engineering department whether there has been a technical conflict of the time of liquidation. The power engineering department, if possible, should adapt to the schedule of the liquidation process presented by the mining and ventilation department as the superior process. The process

of liquidation the processing plant may proceed independently of the liquidation of shafts and workings, the only limitation may be the structure of the mining plant's buildings, technically requiring the liquidation of another object first. The schedule for the liquidation of administrative facilities also runs independently of the main processes. In this case, it is only necessary to plan the order of liquidation of objects in such a way as to leave the objects necessary to support the processes of liquidation of shafts and workings as long as possible.

Here, attention is paid to competence and priority issues. Preparation of applicable procedures in this regard and the design criteria resulting therefrom may, in the event of the possible preparation of the liquidation programs for other mines, help to avoid errors and improve the efficiency of the liquidation processes. In both cases, the authors agreed with the experts, but due to the wide scope of research necessary to implement these postulates, it was assumed that this research problem would be implemented as soon as possible.

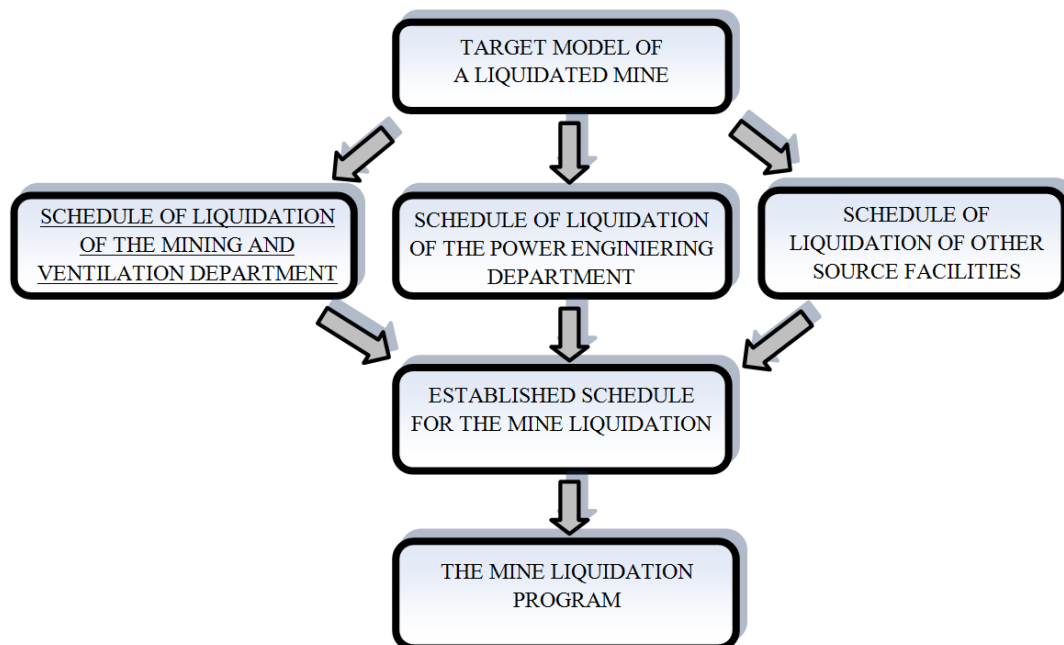


Figure 9. A map of the mine liquidation program preparation process. Source: own study.

6. Conclusion

The conducted research resulted in the following conclusions:

The implementation of the mine liquidation processes has been so far the subject of only random scientific research aimed at determining the principles of activities providing to rationalizing and minimizing costs.

The publication indicates the areas and research problems, which the solution will improve the efficiency and accuracy of the liquidation process.

The project of the mine liquidation is very complex and costly, due to the large scope of the liquidation works to be performed.

The process of liquidation a mining plant requires taking into account a number of interrelated factors of an economic, environmental and legal nature.

Correct definition of the system of processes and activities in the liquidated underground mine should enable the development of a methodology for planning and management of the technical liquidation processes in hard coal mines, allowing for the minimization of costs of activities carried out.

Defining the process of creating costs in the underground mine will allow for the construction of a model methodology of cost rationalization of the technical processes of the liquidation of hard coal mines.

The mapping of the processes taking place during the liquidation will allow for the repeatable mapping of the procedure, ensuring the effectiveness and efficiency of the activities carried out.

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