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COST ANALYSIS AS A PREMISE OF AN ENTERPRISE'S RESTRUCTURING PROCESS[1]

Summary

In this article the stage of an analysis and activity costs assessment was presented as an introduction to determining the direction of enterprise's restructuring. The considerations presented are the results of research conducted in the Central Mine Dewatering Plant which is a part of the Mine Restructuring Cooperative Jsc. At the beginning of the conducted research process technical and organizational conditions of the activity conducted in CMDP were identified. Then an analysis and assessment of unit and total costs were conducted in the units being the part of the examined subject. On the basis of received results the directions of enterprise's restructuring were identified, including technical, organizational and employment restructuring. In the last stage economic effects of the changes introduced were estimated.

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1. Introduction

Restructuring is a process of deep changes in the enterprises structure[2]. Their main premise is a mismatch of particular elements of this structure, influencing the functioning of the whole enterprise and its economic effects[3]. It distances the enterprise from the realization of goal stated and in some cases it makes their realization impossible[4].

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[1] The paper presented the results from the research project of the National Center for Science – *System of cost management in coal mine* (N N524 469239), which is financed by the Polish Ministry of Science and Higher Education.

[2] Compare: Durlik I., *Retructuring of economic processes*, Placet, Warsaw 1998, p. 45-46.

[3] Compare: Borowiecki R., Jaki A., *Restructuring in creating the enterprise's value*, [in:] „Management Problems" 2007, no 1, p. 11.

[4] Compare: Lovett D., Slatter S., *Firm's restructuring. Enterprise management in critical situation*, WIG-Press, Warsaw 2001, p. 100.

Undertaking of restructuring processes is characterized by a number of important indicators[5]. One of them is the historicity manifested in the need of making a detailed diagnosis of the enterprise's condition on the basis of data characterizing its hitherto activities. Another important feature of restructuring is the long-term character, relating both to the length and multiple stages of the restructuring process as well as waiting for its eventual effects[6]. Restructuring should also be characterized by selectivity in relation to the restructured elements of the enterprise structure, as not all of the components require modernization and improvement. However, one should remember about its eventual matching and compatibility. Last but also the most important determinant of restructuring is the rejuvenation of the enterprise as well as providing activity effectiveness[7].

In this article the first stage of restructuring in Central Mine Dewatering Plant belonging to the *Mine Restructuring Cooperative Jsc.* is presented. This stage relates to the analysis and assessment of costs of an examined enterprise activity. On the basis of this analysis' effects, decisions are made about the directions of restructuring with the retaining of its basic determinants. The historicity is realized on the basis of research concerning the costs of activity in years 2006-2009. The long-term perspective relates to the identification of potential effects horizon in perspective to year 2030. Selectivity concerns the extent of the planned changes which encompass only those plants of the examined enterprise, which because of the height of borne costs should and can be modified. The rejuvenation is the creation of a new organizational and technical structure of restructured subject leading to a radical reduction of activity costs and, therefore, an improvement of activity effectiveness[8].

In the light of the above, the research problem undertaken in this article can be formulated in the following way: In what way using the activity costs analysis and assessment can new directions of enterprise restructuring be determined? The goal of the article is to identify the key areas of restructuring in the Central Mine Dewatering Plant by the use of activity costs analysis and assessment.

To fulfill such goal, in the first part of the article a diagnosis of the condition of the examined subject with the inclusion of the unit and overall costs' levels of plants functioning as its part. Then, changes in the technical and organizational structure of the examined enterprise were suggested. On the basis of specified modifications a forecast of unit and total costs up to year 2030 was made and the effectiveness of suggested solutions was assessed[9].

2. Specificity of the restructured enterprises activity

The process of hard coal mining industry restructuring caused the liquidation of unprofitable mines which apart from the social issues, created technical problems connected with the securing of existing mines from water threat.

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[5] More: Turek M., *Technical and organizational restructuring of hard coal mines*, Central Mining Institute, Katowice 2003.

[6] More: Faulhaber P., Landwery N., *Turnaround – management in practice*, CeDeWu, 2005, p. 13.

[7] More: Zadora H., *Restructuring. The process of enteprise's rejuvenation.* [in:] *Small enterprise's finance in management theory and practice.* ed.: Zadora H., C. H. Beck, Warsaw 2009, p. 299-312.

[8] Compare: Rochoń M., *Financial restructuring effectiveness of Polish enterprises, on the basis of legal procedures – a synthetic approach*, [in:] „Organization Overview" 2006, no 12, p. 34-37.

[9] More. Podczarski S., *Effectiveness of restructuring processes in industry enterprises – an identification attempt.* [in:] „Organization Overview" 2006, no 6-7, p. 51. More: Jonek-Kowalska I., Turek M., *Financing of restructuring processes in hard coal mining in years 2003-2006,* [in:] *Restructuring management in integration and new economy development processes,* ed.: Borowiecki R. and Jaki A., University of Economics in Kraków, Kraków 2008, p. 561-573 and Jonek-Kowalska I., Turek M., *Enterprise concentration and its effects on the ex ample of Kompania Węglowa Jsc.* [in:] *Restructuring management in integration and new economy development processes*, ed. Borowiecki R. and Jaki A., University of Economics in Kraków, Kraków 2008, p. 573-589.

As a result of mining done in the past, between neighboring mines there is a number of direct connections, mainly through old mining excavations. Existing border pillars, quite narrow – some no thicker than few meters, were damaged by mining works and are no longer a barrier for water migration.

Because of the water threats the direct links by the way of shoots remaining after mining and excavation passages have critical meaning. In former mining areas with liquidated mines there are dozens or even hundreds of kilometers of mining excavation passages which create a complex network of communicating vessels with an unrestricted freedom of water movement. Each of such passages in case of a close contact with the excavation of a neighboring mine forms water threat after being filled with water . After finishing of mining in the mountain formation, good conditions for gathering of subterranean waters are created, which form receptacles with volume reaching sometimes several million of cubic meters.

In such situation, in some of the liquidated mining plants, there is a need of constant dewatering of mining excavation and keeping the water level on safe heights in order to prevent a rapid and uncontrolled intrusion of water to neighboring active mines. The possibility of rapid water intrusion to active mines with catastrophic effects is the essence of water threats to the mining teams working there.

In the light of the above, the aspect of water threat must be the superior goal that each institutions connected with mine liquidation should take into consideration. The costs of maintaining a dewatering system in liquidated mines, although also important as they are covered from public means, cannot decide about stopping or choosing the way of dewatering. However, in longer perspective one should consider their rationalization from the point of view of economy rule realized from public funds.

The effect of the complex geological and mining situation is that, despite partial or total mine liquidation, because of the need to secure active mines from water threats, in most cases it is impossible to stop dewatering mines after their liquidation. Thus, these are mainly security concerns which decide that despite liquidation of numerous mines, their dewatering must be continued and costs connected with maintaining the subterranean and surface infrastructure connected with dewatering must be borne.

In order to concentrate tasks connected with pumping of pit waters after liquidated hard coal mines, Central Mine Dewatering Plant (CMDP) was created. The CMDP plant encompasses 18 dewatering regions, created on the basis of liquidated mines parts.

The task of the Central Mine Dewatering Plant is the securing of active mines from water threats through dewatering, by the use of stationary or depth pumps, of liquidated hard coal mines.

The need to maintain dewatering generates significant water pumping costs. Especially high are the costs of pumping waters in stationary systems, in which there is a need to maintain a large number of mining excavations, with a relatively numerous personal staff. Therefore, the use of depth dewatering systems in mines is more and more common.

The use of depth systems increases the security both in the liquidated mines as well as neighboring mines. This system allows to lead out the teams from mines. The use of depths pumps allows to control the water damming levels in the mountain formation depending on local hydro-geological and mining conditions.

Stationary pumping stations are very vulnerable to possible water intrusions form neighboring liquidated mines. Drowning of undershaft excavation can cause pump engines and electrical switchgear to become flooded and in this way stop the pumping stations. Depth pumps are working mostly submerged and have water-cooling engines, while their switchgears are on the surface. In such a case, flooding of the level and rising of the water level even for few meters have no significant meaning. However, it has to be emphasized that because of existing barriers, both hydro-geological and mining, depth systems are impossible to be used in every mining and hydro-geological conditions.

In the examined Central Mine Dewatering Plant there are 7 stationary regions working (Saturn, Siemianowice, Jan Kanty, Szombierki, Pstrowski, Powstańców Śląskich, Dębieńsko) and 7 depth pumping

stations (Paras, Niwka-Modrzejów, Sosnowiec, Gliwice, Grodziec, Katowice, Porąbka-Klimontów). Furthermore, the Kleofas is a depth region from August 2007.

3. Unit costs analysis of stationary and depth units

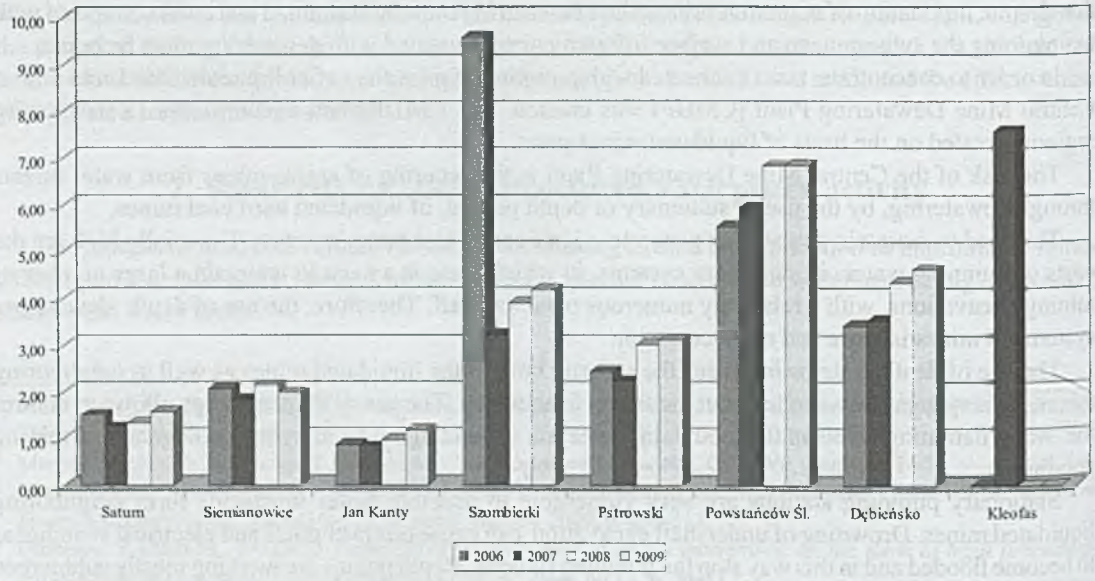
In this part in order to identify basic areas of planned restructuring, unit dewatering costs in stationary and depth regions in years 2006-2009 were analyzed. It will allow to determine the extent of potential organizational and technical changes in dewatering systems aimed at reducing costs of CMDP activity.

Average unit cost of pumping in years 2006-2009 in stationary pumping stations was formed in the following way:

Jan Kanty	0.94 PLN/m^3
Saturn	1.41 PLN/m^3
Siemianowice	1.99 PLN/m^3
Pstrowski	2.69 PLN/m^3
Dębieńsko	3.95 PLN/m^3
Szombierki	4.49 PLN m^3
Powstańców Śląskich	6.28 PLN/m^3
Kleofas (up to 08.2007)	**7.57 PLN/m^3**

As a supplement to the summary described in figure 1, a detailed list of unit dewatering costs in stationary regions of CMDP in years 2006-2009 was presented.

Figure 1. Unit dewatering costs in stationary regions of CMDP in years 2006-2009 (in PLN/m^3)



Source: own work based on internal CMDP materials.

The highest unit pumping cost was noted in year 2007 in Kleofas Region, i.e. 7.57 PLN/m^3. In this period with the stationary system only 1.15 million m^3 were pumped, because of water retention conducted in shoots, in relation to the construction of depth pumping station in this region. With the decreased amount of pumped water, all the costs of maintaining works, such as adapting the shaft to serve

as a deep well, purchase of equipment for a depth pumping station, rebuilding of the energy network, purchase of communication system, reparations of pipelines, construction sites and installations were incurred. The total cost of supplemental works amounted 1.1 million PLN.

In other stationary pumping stations in which there were no works connected with changing of the dewatering system, the highest unit cost was incurred by the Powstańcy Śląscy Region. This cost, in year 2006-2009, amounted 6.28 PLN/m^3. With a relatively low water inflow, amounting in years 2006-2009 on average 1.54 million /m^3, maintaining of two pumping stations of main dewatering, one water house and about 17 km of excavations was necessary.

The lowest unit cost in stationary pumping stations was borne in Jan Kanty region and in years 2006-2009 amounted 0.94 PLN/m^3. In this region, stationary dewatering system is maintained with one pumping station of the main dewatering at the level of 270m and about 7.3m excavations with an average annual inflow in years 2006-2009 amounting 14.86 million m^3. The dewatering system in Jan Kanty region, in comparison to the system in Powstańcy Śląscy is characterized by a much simpler structure. The depth from which water is pumped is twice lower, the number of excavations maintained is twice lower and only one pumping station is maintained. This means that no matter how much water is pumped in this region, high costs of maintaining technical infrastructure are borne.

Because of the differencing in the quantity of water flowing in (in years 2006-2009 59.44 million m^3 in Jan Kanty region and 6.17 million m^3 in Powstańcy Śląscy region) the unit cost of pumping water in Powstańcy Śląscy region is seven times higher than the cost in Jan Kanty region.

In case of Saturn and Siemianowice, at the inflow of waters in years 2006-2009, amounting 47.70 million m^3 in the former and 52.65 million m^3 in the latter, the unit cost amounted respectively 1.41 PLN/ m^3 and 1.99 PLN/ m^3, which means that in Siemianowice region this cost was by 41% higher than the unit cost in Saturn region. It is caused by a much more complex technical infrastructure in Siemianowice region. In Saturn region at the level of 210m two stationary pumping stations and a water house 'Andrzej' are functioning and, additionally, 5690m of mining excavation passages are maintained as well as two shafts – 'Paweł' inspiratory-downhill and 'N-II' ventilation. In Siemianowice region there are two stationary systems functioning which require to maintain 15 365 meters of paved excavations (almost 2.5 times more than in Saturn region), 4 shafts, 2 smaller shafts and 4 stationary pumping stations. This results in the fact that, with a comparable amount of pumped water, the cost of maintaining Siemianowice region is higher that maintaining of the Saturn region, which influences differences in unit costs.

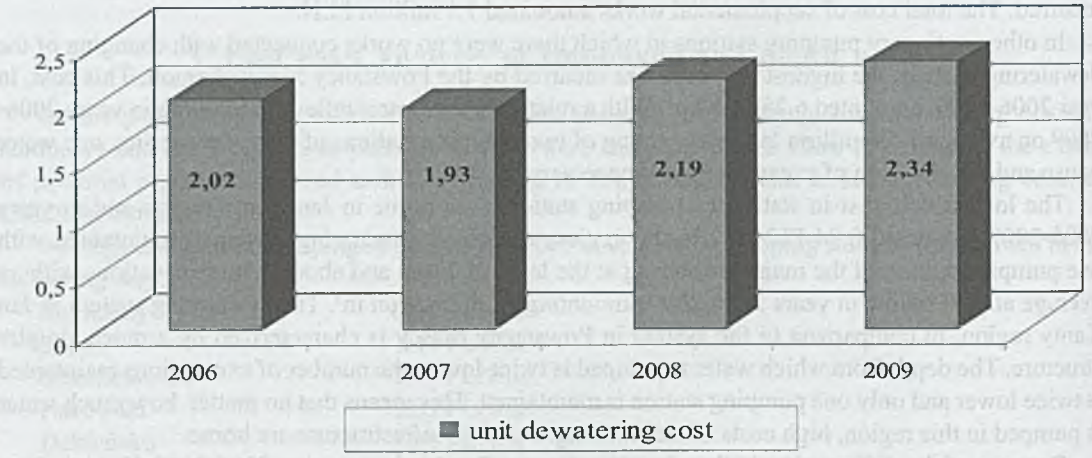
High unit pumping cost occurs also in Szombierki region. This cost on average in years 2006-2009 amounted 4.49 PLN/m^3. In this region waters are pumped from considerable depth (two pumping stations of main pumping at the levels of 630m and 790m) and 6 590.0m of excavation passages are maintained as well as 1 shaft 838.1m deep which affects the high cost of maintaining the region, while the water inflow is small and in years 2006-2009 amounted only 8.91 million m^3.

In case of Dębieńsko region, the unit cost in years 2006-2009 amounted 3.95 PLN/m^3 and was considerably higher than the average for stationary CMDP pumping stations which amounted 2.12 PLN/m^3. It is caused by the necessity of maintaining a complex pit infrastructure. In this region 2 shafts are maintained with a total depth of 1 399.4m, pavement excavations at 6 levels with a total length of 8 671.0m and 3 pumping stations of main dewatering. A high cost of maintaining this infrastructure results in a high level of unit pumping cost.

According to the above, unit cost is mainly dependent on the quantity of pumped water and technical factors. Among the most important there are: complexity of the dewatering system, number of pumping stations and water houses, length of excavation passages, depth of pumping and the number of shafts and smaller shafts.

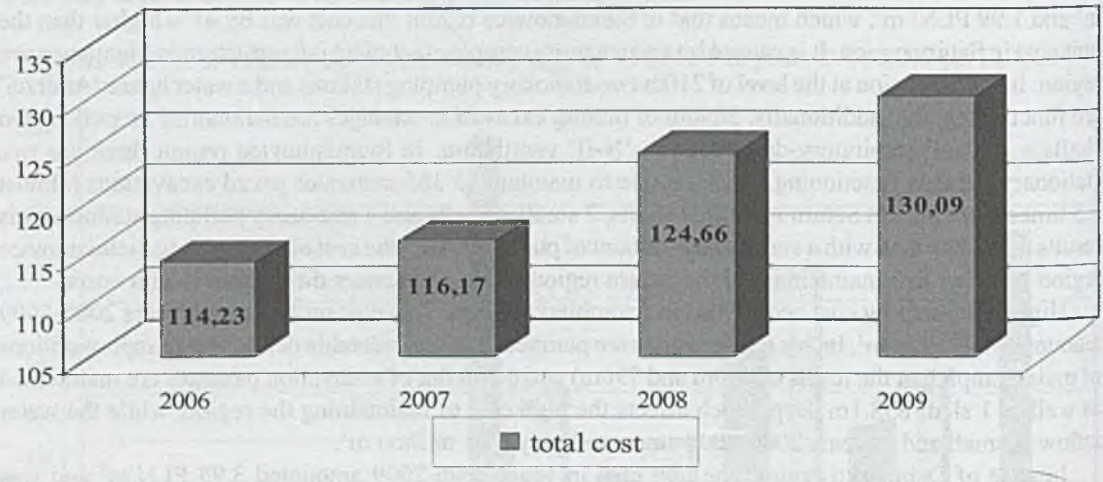
As a summary of the unit and total costs analysis in stationary pumping stations, in figures 2 and 3, an average level of those costs in years 2006-2009 is presented.

Figure 2. Average unit cost of dewatering in stationary regions in years 2006-2009 [in PLN/ m³]



Source: own work based on the CMDP internal materials.

Figure 3. Total costs of dewatering in stationary regions in years 2006-2009 [in PLN/ m³]



Source: own work based on the CMDP internal materials.

A similar analysis was conducted on the dewatering costs in depth regions. Average unit pumping cost in years 2006-2009 in depth pumping station was as follows:

Paris	0.63 zł/m³
Niwka Modrzejów	1.16 zł/m³
Sosnowiec	1.23 zł/m³
Gliwice	1.27 zł/m³
Grodziec	1.40 zł/m³
Katowice	1.39 zł/m³
Porąbka-Klimontów	1.95 zł/m³
Kleofas (from 08.2008)	2.15 zł/m³

In case of a depth pumping station big changes in unit costs borne in particular years are characteristic. It stems from the purchases of depth aggregates made in pumping stations and investments connected with it. The most important reasons for unit cost changes in particular regions are presented below:

In Sosnowiec region in year 2006 the unit cost amounted 0.79 PLN/m^3, in year 2007 - 1.07 PLN/m^3, in year 2008 - 2.26 PLN/m^3 and in year 2009 amounted 1.21 PLN/m^3. A significant increase in costs in year 2008 was caused by the purchase of 1 aggregate with equipment for 2.8 million PLN. The realization of this purchase, with a decrease of the quantity of pumped water (as a result of damming) caused unit costs to rise more than twice.

In Paris region in year 2006 the unit cost amounted 1.15 PLN/m^3, in year 2007 - 0.47 PLN/m^3, in year 2008 - 0.36 PLN/m^3 and in year 2009 amounted 0.59 PLN/m^3. The increase of units cost was influenced by a purchase of 4 aggregates for 3.3 million PLN.

In Porąbka-Klimontów region in year 2006 the unit cost amounted 1.70 PLN/m^3, in year 2007 - 4.22 PLN/m^3, in year 2008 - 0.80 PLN/m^3 and in year 2009 amounted 1.24 PLN/m^3. In this region in year 2006 a one-time order was realized– reparation of the Mortimer Trench for 1.4 million PLN. In year 2007 3 aggregates were bought with equipment and unnecessary equipment in the shaft was liquidated, the operational bridge in the shaft as well as a support head for the construction of new aggregates were built over for a total amount of 5.5 million PLN (including the aggregates for 4.7 million PLN). Those investments caused a considerable increase of unit costs in years 2006-2007.

In Grodzice region in year 2006 the unit cost amounted 1.42 PLN/m^3, in year 2007 - 1.33 PLN/m^3, in year 2008 - 1.71 PLN/m^3 and in year 2009 amounted 1.28 PLN/m^3. In this region 1 aggregate was purchased with equipment for 0.9 million PLN. In years 2007-2009 no aggregate or equipment purchases were realized and because of the water damming, finished on 17.03.2009 the amount of water pumped was decreasing. In year 2006 1.30 million m^3 water were pumped, in year 2007 - 0.51 million m^3 and in 2008 - 0.31 million m^3, and in year 2009 2.98 million m^3. Because of the finishing of water damming in March 2009 the costs of region maintenance increased.

In Katowice region in years 2006, 2008 and 2009 the unit cost was on a comparable level (1.07 PLN/m^3 in 2006, 0.87 PLN/m^3 in 2008, 1.03 PLN/m^3 in 2009). In year 2007 it increased almost two times to the level of 2.61 PLN/m^3 which was caused by the purchase of 2 units of aggregates for 3.4 million PLN.

In Niwka-Modrzejów region in years 2006, 2008 and 2009 the unit cost was at a stable level (0.8 PLN/m^3 in 2006, 0.82 PLN/m^3 in 2008, 1.04 PLN/m^3 in 2009). In year 2007 it increased to the level of 2.1 PLN/m^3 which was caused by the purchase of 3 units of aggregates for 4.3 million PLN.

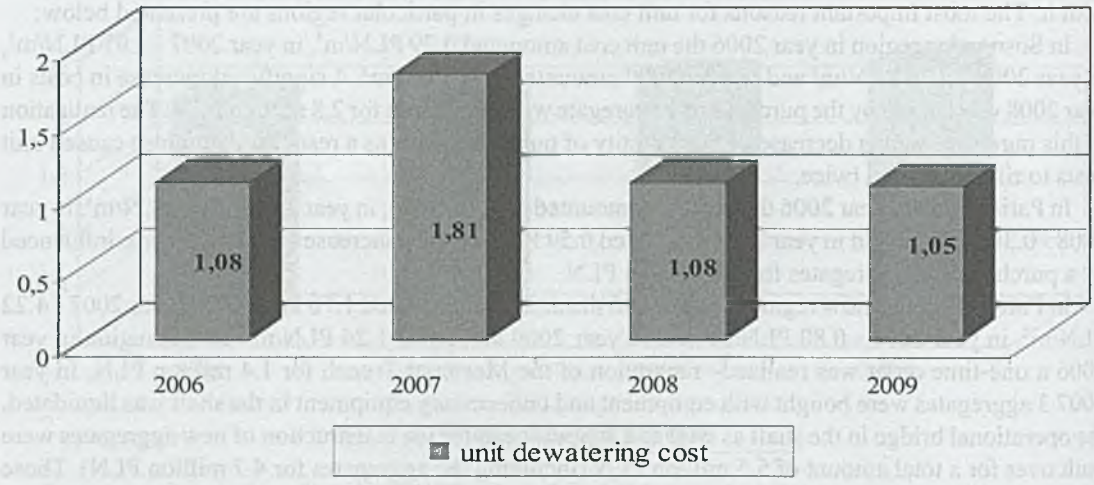
In Gliwice region in years 2006, 2007 and 2009 the unit cost was at a stable level (1.07 PLN/m^3 in 2006, 0.96 PLN/m^3 in 2007, 1.16 PLN/m^3 in 2009). In year 2007 it increased to the level of 1.87 PLN/m^3 which was caused by the purchase of 1 aggregate for 1.9 million PLN.

In Kleofas region in year 2007 the unit cost amounted 3.89 PLN/m^3, in year 2008 it decreased to 1.83 PLN/m^3 and in year 2009 to 1.63 PLN/m^3. The depth pumping station was opened in August 2007 and in this year the costs connected with the change of the dewatering system in the amount of 1.1 million PLN were borne.

According to the above the periodical abrupt changes in depth regions are caused mainly by investments related to the purchase of aggregates with equipment. The unit cost fluctuations are also influenced by changes connected with the quantity of water pumped as an effect of water damming in particular regions. Without the inclusion of borne investments the unit dewatering cost does not exceed 1.50 PLN/m^3.

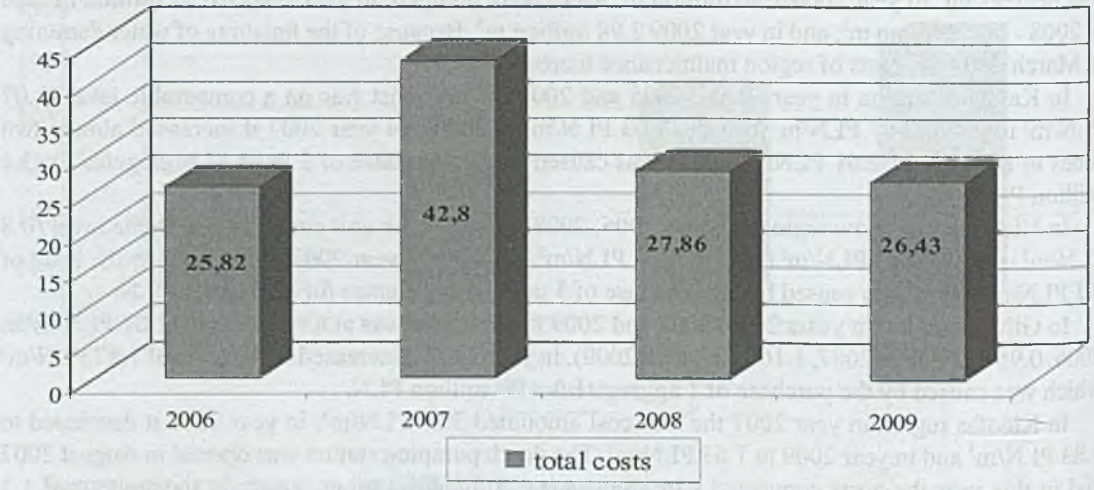
As a summary of the unit and total cost analysis in depth pumping stations in figures 4 and 5 the average level of those costs in years 2006-2010 is presented.

Figure 4. Average unit dewatering cost in depth regions in years 2006-2009 [in PLN/ m³]



Source: own work based on CMDP internal materials.

Figure 5. Total dewatering costs in depth regions in years 2006-2009 [in PLN/ m³]



Source: own work based on CMDP internal materials.

The highest maintenance costs were borne in year 2007, which was connected with the investments described earlier. In other periods the costs were at the stabilized range pf 25.82-26.5 million PLN.

To sum up the considerations above, it should be stated that the unit costs in stationary regions are twice as high as in depth regions. Furthermore, total maintenance costs of stationary regions in the whole examined period exceed the value of 110 million PLN and rise sharply in the last two years of the analysis (2008 - 124.66 million PLN, 2009 – 130 million PLN). The total costs of maintaining depth regions are considerably lower and apart from the period of intensive investments (year 2007 – 42.8 million PLN) they do not exceed 28 million PLN).

To conclude the cost analysis, it is worth adding that the specificity of stationary and depth regions results in that in those regions different cost positions are dominant. From the historical analysis of generic costs conducted for years 2006-2010 it seems that in the stationary regions the generic costs are dominated by: use of energy, salaries, foreign services, taxes and payments.

On the other hand, in depth regions, undoubtedly the highest share in generic costs is held by the use of energy and amortization. Salaries and foreign service form a minor supplement. In both systems other generic costs, which participation in the costs structure does not exceed 5%, are of little importance.

A factor that strongly determines the costs of dewatering in stationary plants is the cost of salaries. In stationary regions in the examined period over 600 people were employed. In the depth regions between 2 and 6 people, delegated from stationary pumping stations, are employed.

4. The extent of technical and organizational restructuring in the examined enterprise

In the area of existing dewatering systems a number of changes and modifications oriented at a reduction of maintenance costs of all functioning plants in the examined enterprise is possible. The planned restructuring is above all an organizational restructuring, heading towards the simplification of the existing organizational and property structure. Its consequence will be also a staff shift and an employment reduction in some plants, which is a determinant of employment restructuring.

While planning the restructuring and identifying its effects, the following variants were considered:

Variant 0 – the base one, in which apart from current rebuilding investments and opened investments no transformations in the existing dewatering systems are considered. This variant is a starting point for calculating the differences in dewatering costs in following scenarios.

Variant I – assuming the modernization and rebuilding of existing pumping stations,

Variant II – assuming the modernization and rebuilding suggested in variant I and construction of a new depth pumping stations.

A detailed list of changes along with investments required for particular variants are presented in table 1.

Table 1. Variant changes in dewatering systems

Variant / Region	0	I	II
STATIONARY REGIONS			
Saturn	Finishing of transformation of the pumping station from stationary to depth (1,5 million PLN)	Taking over the water from liquidated stationary regions 8 and 9 Employment reduction from 175 to 10 people	Taking over the water from liquidated stationary regions 8 and 9 Employment reduction from 175 to 10 people
Siemianowice	No changes	No changes	No changes
Jan Kanty	No changes	Maintenance of the stationary dewatering system and simplification of its construction (16,5 million PLN) Employment reduction from 67 to 40 people	Maintenance of the stationary dewatering system and simplification of its construction (16,5 million PLN) Employment reduction from 67 to 40 people

Szombierki	No changes	No changes	No changes
Pstrowski	No changes	Modernization of the dewatering system (liquidation of part of excavations, 3.0 million PLN)	Liquidation of the region and construction of a new pumping station (30 million PLN)
Powstańców Śląskich	No changes	Pouring of waters to the active mine and liquidation of the pumping station (16.7 million) Employment reduction by 47 people.	Pouring of waters to the active mine and liquidation of the pumping station (16.7 million) Employment reduction by 47 people.
Dębieńsko	No changes	New mining plant takes over the catering region	New mining plant takes over the catering region
DEPTH REGIONS			
Sosnowiec	No changes	Liquidation of the pumping station and pouring the water to pumping station 1 Transferring of employees to pumping station 1	Liquidation of the pumping station and pouring the water to pumping station 1 Transferring of employees to pumping station 1
Paris	No changes	Liquidation of the pumping station and pouring the water to pumping station 1 Transferring of employees to pumping station 1	Liquidation of the pumping station and pouring the water to pumping station 1 Transferring of employees to pumping station 1
Porąbka-Klimontów	Building of third depth pumping station (1.0 million PLN)	Building of third depth pumping station (1.0 million PLN)	Building of third depth pumping station (1.0 million PLN)
Grodziec	No changes	Liquidation of the pumping station (1.3 million PLN) Employment reduction by 6 people	Liquidation of the pumping station (1.3 million PLN) Employment reduction by 6 people
Katowice	No changes	No changes	No changes
Niwka-Modrzejów	No changes	No changes	Liquidation of pumping station and pouring of water to the active mine (3 million PLN)
Gliwice	No changes	No changes	No changes
Kleofas	No changes	No changes	No changes

Source: own work based on CMDP data.

According to the data presented in table 1 the biggest changes and modernization are related to stationary pumping stations, in which the maintenance costs are the highest. In those pumping stations deep property changes, including the changes of dewatering system are planned. The whole enterprise is subjected to organizational transformations as a result of liquidation of some of the plants. Finally,

an employment reduction and a transfer of employees from liquidated mines to active pumping stations are also assumed.

5. Predicted effects of the taken restructuring actions

After determining of suggested organizational and technical changes in the existing CMDP systems a forecast of unit costs up to year 2030 was made. It allowed the determination of the total CMDP costs level and their reduction in relation to the variant 0 – with no investments. Additionally, while creating the forecasts the following general assumptions being in force in each of the variants analyzed were made:

1. The forecast is based on the generic costs system, in which salaries, use of energy, foreign services, use of materials, amortization and other generic costs are taken into account.
2. In the forecast individual (separate for each region) econometric regression models built based on the historic analysis of generic costs in particular regions in years 2005-2010 (up to and including July) are used. In order to objectify research for model construction monthly data were used and 67 cost lists in generic costs system were received in that way.
3. The quantity of pumped water, which was forecasted individually for each of the regions on the basis of historical value of pumped water in years 2005-2010 (up to July), was assumed to be the parameter shaping the unit dewatering cost.
4. While planning the investments, information was gathered in the Mine Restructuring Cooperative Jsc., in active mines as well as materials on the subject of already finished investments in the examined dewatering regions.
5. In order to estimate changes in costs resulting from realization of different scenarios, each of the regions was individually considered while taking into account the planned periods of returns of investments. The changes were analyzed in the context of their influence on particular generic costs' position. Also the effects of the previously finished investments of a similar character were examined in order to avoid under- or overestimation of the effects of planned undertakings.

After a detailed analysis of costs in particular regions, a list of unit and total costs, with scenarios 0-II taken into consideration, was made. Then changes in costs in relation to the variant 0 were identified.

As it was mentioned earlier, the base variant assumes the functioning of existing dewatering regions without making any significant changes in the existing systems. In this variant the following detailed assumptions were made.

1. Rise of wages consistent with the forecast of GDP growth in years 2011-2030,
2. Rise in electricity prices consistent with the Polish Energy Policy up to year 2030,
3. Rise in the value of foreign services, materials and other generic costs as well as taxes and payments on the inflation level.

Furthermore, variant 0 takes into consideration the investments already realized and requiring only finishing in the following regions:

1. Saturn – completion of the transformation into a depth pumping station – the cost of investment amounted 1.5 million.
2. Porąbka – Klimontów – adjusting of the Ryszard shaft to the building of third depth pumping station – investment cost 1.0 million.

In variant I the forecast of generic costs, both unit and total, was presented for particular regions of dewatering, taking into consideration the general assumptions from variant 0. Additional investments and effects connected with investments planned in given regions were considered.

In variant II the modifications presented in point 4 were additionally taken into consideration. They concern:

Table 2. Variant analysis of total maintenance costs of dewatering regions – an average level of water pumped [in thousand PLN]

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total	Reduction in % in relation to variant 0
Variant 0 total costs	209 304	195 426	202 319	210 328	218 420	228 716	237 274	248 116	259 311	270 987	279 376	285 957	294 860	304 559	314 601	324 875	335 687	347 068	359 048	371 660	5 497 893	-
Variant I total costs	215 134	213 024	216 992	210 491	180 771	188 981	195 351	203 560	210 498	219 634	225 867	230 260	237 046	244 126	251 516	258 866	266 554	274 593	283 001	291 793	4 618 057	16.0%
Variant II total costs	212 272	213 024	254 092	213 286	178 505	186 619	192 914	201 406	208 316	217 448	224 064	229 755	236 983	244 539	252 437	260 374	268 688	277 395	286 515	296 067	4 654 699	15.3%

Source: own work.

Table 3. Variant analysis of total maintenance costs of dewatering regions – wet years [in thousand PLN]

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total	Reduction in % in relation to variant 0
Variant 0 total costs	221 087	207 684	215 052	223 536	232 103	243 220	252 599	264 262	276 278	288 775	297 235	303 887	312 862	322 631	332 745	343 004	353 802	365 168	377 134	389 731	5 822 792	-
Variant I total costs	226 917	225 282	229 725	223 706	191 432	200 281	207 290	216 138	223 716	233 491	239 781	244 229	251 071	258 208	265 654	272 994	280 671	288 701	297 098	305 880	4 882 264	16.2%
Variant II total costs	224 055	225 282	266 825	227 494	190 271	199 062	206 037	215 212	222 808	232 630	239 373	245 194	252 556	260 251	268 292	276 313	284 715	293 516	302 735	312 392	4 945 015	15.1%

Source: own work.

1. The liquidation of the Pstrowski region and pouring the water to KWK Bobrek-Centrum. The investment cost was estimated to be 30 million PLN. The unit cost of pumping of one cubic meter in KWK Bobrek-Centrum was estimated on the basis of SRK Jsc. data.
2. Liquidation of the Niwka-Modrzejów region and pouring the water to KWK Mysłowice-Wesoła. The investment cost was estimated to be 3 million PLN. The unit cost of pumping in KWK Mysłowice-Wesoła was estimated to be 1.51 for m^3 (current cost of pumping of $1m^3$ from the level of 665m – the deepest – data of KHW Jsc.)
3. In other regions the cost level is consistent with that of variant I.

Detailed conclusions related to the possibility of restricting the costs of financing CMDP are presented in tables 2 and 3, relating to the variant analyses of total dewatering costs.

6. Conclusion

In the **(optional) variant I,** assuming:

- finishing of transformation of Saturn region to a depth plant,
- maintaining of a stationary main dewatering system in Jan Kanty region, assuming the maximum modernization and simplification of the current system,
- modernization of the dewatering system in Pstrowski region, including a liquidation of 3.8 kilometers of pavement excavations at the level o 575m,
- liquidation of the Powstańcy Śląscy region and transferring the water to the KWK Bobrek-Centrum dewatering system,
- liquidation of the Dębieńsko region because of taking over the dewatering system by a new mining plant,
- maintenance of a stationary central dewatering system in Jan Kanty region, ta king into consideration the maximum modernization and simplification of the current system,
- liquidation of Sosnowiec region and transferring the water to the Saturn region,
- liquidation of Paris region and transferring the water to the Saturn region,
- adapting of the Ryszard shaft to the building of the third depth pumping station in the Porąbka-Klimontów region,
- liquidation of the Grodziec region,
- constant functioning of other pumping stations (Kleofas, Gliwice, Niwka-Modrzejów, Katowice, Szombierki, Siemianowice),

a 16-percent dewatering costs reduction in the regions of Central Mine Dewatering was achieved. The costs reduction is related mainly to ceasing of pumping water in the liquidated regions. After taking into consideration the increased quantity of pumped water (wet years) the cost reduction will amount 16.2%.

In variant I apart from transferring water from Powstańscy Śląscy region to KWK Bobrek-Centrum, engaging active mines in the processes connected with dewatering system simplification is not assumed. The cost of pumping water to KWK Bobrek-Centrum is borne by SRK Jsc. and in the first year of the forecast it amounts 4 702 thousand PLN. Then, it is systematically indexed under variant 0 assumptions (rise of wages, materials and services prices, taxes, payments and energy). In the period 2014-2030 it amounts a total of 110 182 thousand PLN.

In the **(extreme) variant II assuming** additionally, (apart from changes included in option I):

- liquidation of Pstrowski region and tranferring water to KWK Bobrek-Centrum,
- liquidation of Niwka-Modrzejów region and tranferring water to KWK Mysłowice-Wesoła – Ruch Wesoła, an **over 15-percent reduction** (15.3%) of total costs was achieved. The decrease in costs is in this case also the effect of ceasing the pumping in regions that are liquidated. After taking into

consideration the increased quantity of pumped water (wet years) the cost reduction will amount 15.1%.

However, it is important to note that in the presented variant changes require additional investments made by SRK Jsc. These are the investments borne because of the construction of new pumping station in KWK Bobrek-Centrum (the costs are estimated to 35 million PLN) and investments related to the connection of Niwka-Modrzejów region with Rucha Wesoła in KWK Mysłowice-Wesoła (cost of investment 3 million PLN). The presented investments in a significant way decrease the effectiveness of the variant considered (in relation to variant I). With the lengthening of the forecast horizon the effectiveness of variant II would be improved.

In the extreme variant II SRK Jsc. covers also the costs of pumping water to KWK Bobrek-Centrum (a total in years 2014-2030 – 532 297 thousand PLN) and KWK Mysłowice Wesoła (a total in years 2015-2030 – 159 201 thousand PLN).

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