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Indicators of the quality of production of raw coal mine in case study

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Abstract
There is in a paper presentation of an analysis of the quality of production carried out on the example of the production of raw coal in selected mines. The aim of the publication was to analyze the indicators to determine the extent to which the objectives have been met, and thus whether the process is of sufficient efficiency.

Introduction

This paper presents an analysis of the quality of raw coal production on the example of selected mine. The aim of the study was to verify the effectiveness of the quality management system in this field and to investigate the variability of the direction indicators. The basis for the implementation of the quality management system is to develop its documentation. Important document system is the quality policy. The Board declares in her own commitment and allocation of funds and resources to implement the system. Politics is part of the company's strategy. It refers to the mission and strategic objectives of the company. It includes a commitment for the company to meet customer requirements and continuous improvement of the quality system. The quality policy is the basis for determining the specific objectives called quality objectives [1].

The quality manual is a description of a system operating in a particular company. It presents the company's quality policy and the overall structure of the system. It describes in general terms the way, in which the company intends to meet the requirements of customers for the quality of their products. The structure and contents of the quality manual depend largely on the nature and size of the company and the adopted model of the system [2]. Procedures describe the objectives, responsibilities and the manner of execution of tasks in the system of quality management. Specify where, when, by whom and how tasks are to be carried out. They can take many forms (verbal description, the card pass, blocks diagrams, etc.) depending on the size of the company, the specification of its operations and the intended scope and structure of the book quality [3, 4].

ISO 9001:2009 sets out the basic requirements of quality management systems building. It contains general principles of quality management system documentation requirements and the basic terms and definitions related to quality. ISO 9001:2009 says among other things that "The organization shall establish, document, implement and maintain a quality management system and continually improve its effectiveness in accordance with the requirements of the International Standard" [5, 6, 7, 8, 9].

There are many evidences that the introduction of the organization referred to the concept of quality and its consistent compliance has a positive (and often decisive) influence on the efficiency and effectiveness of the implemented activities and the quality of the products that it provides. Quality Management Systems (QMS) are built and developed mostly on the basis described in the standards requirements. I belong to emphasize that there are

no regulations that would force organizations to use them. In theory, companies can build quality management systems without reference to the requirements of the standards; systems conceived in this way can be effective and efficient. The problem is, however, so the implemented QMS authentication on the market. The lack of reference to the requirements of standards makes it difficult to be ruled out is the possibility of system certification by a third party. As a result, the company, having an efficient and effective QMS has difficulty in competing with a company that has a certified quality system [10, 11, 12, 13].

The standard requires particular process indicators to monitor the level of quality of the process. Assess the effectiveness of processes is done by analyzing the obtained values of the individual measures. For each meter set tolerance or allowable deviation and the laps of time measurement. Depending on the type of meter, the expected value of its scheduled may be different for each Timeout. The process is considered to be effective for achieving all of its expected value indicators, including the acceptable tolerance [14, 15, 16, 17, 18, 19].

If the vast majority of indicators achieved the expected value, the analysis of the impact of other indicators on the process, this process can be considered effective. In the case of inefficient processes analyzed the reasons for not achieving the expected value and implements necessary, corrective action.

The process of producing raw coal

The production process of raw coal is schematically shown in figure 1 have been described for the process of data input, the production process of raw coal and the data output. The figure also indicates the procedures that are used in terms of inputs and outputs of the production process from the process.

The purpose of the production of raw coal is: to ensure proper preparation and use of the bed in a planned and supervised, in accordance with arrangements designed, approved technical documentation, fulfilling all legal requirements relating to the production of raw coal in order to prevent any loss of quality of extracted raw material as well as to provide material for processing of the required parameters. The owner of the process is the manager of mining [20, 21, 22].

To monitor the process and its quality should be used quality management system to determine the quality of the process. Measurement and control of these indicators will guarantee the efficiency of the process and thus its quality level. Table 1 presents

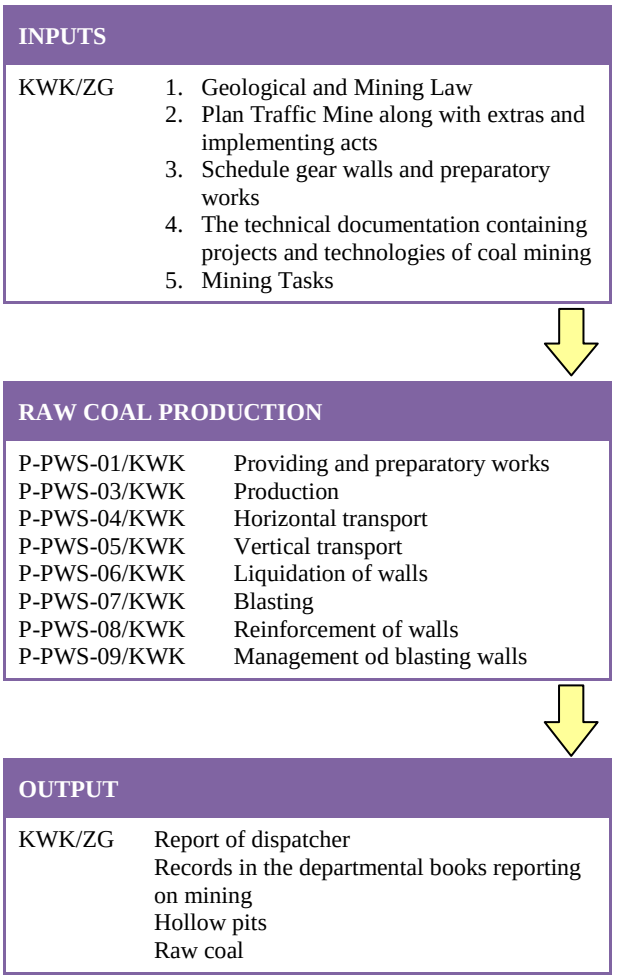

Fig. 1. The production process of raw coal [23]

selected indicators of the effectiveness of the production of raw coal. These indicators are in turn defined and described in terms of the expected value of the index and the effectiveness of the adopted criterion (permitted limit indicator), the frequency of measurement of the rate to be applied, and the person responsible for its monitoring.

In practice, the supervision process described fully Quality Department. The Quality Department is subject to substantive Director of Customer Service and Quality Control Head KW SA, while in terms of geological and mining Traffic Manager Branch Mine KW SA Quality Department formed two divisions: Division of Coal Quality Control and Laboratory Division.

The most important tasks of the Quality Control Division of Coal include activities, such as:

- Quality control of commercial coal:
  - collection and preparation of samples of commercial coal for chemical analysis (assortments thick, medium, fine, fines, silt);
  - collection and preparation of control samples, of the general sample preparation and conduct their records.

Table 1. The performance indicators of raw coal production [23]

Indicators of the effectiveness of the process – PWS Production of raw coal					
Name	Definition	The expected value	The criterion of effectiveness (the permissible limits of the meter)	Frequency measure-ment	Responsible for monitoring
Implementation of preparatory works in total	Made preparatory works [mb] / Plan preparatory works [mb] × 100%	The plan of work prepared stuffs 11 610 mb	95–100%	Month	Deputy Head of Mining Works, Head of Mining Works (TG-2)
Time reinforcement wall	The resulting wall charging time [days] / Average esti-mated time of reinforcement wall [days] × 100%	Average estimated time of reinforce-ment wall 42 days	90–100%	Month	Deputy Head of Mining Works, Head of Mining Works (TG-3)
Time of the liquidation of wall	The resulting time liquida-tion of wall [days] / Average estimated time of liquidation of the wall [days]x 100%	Average estimated time of liquidation of wall 42 days	90–100%	Month	Deputy Head of Mining Works, Head of Mining Works (TG-3)
Total extraction	Number of extraction [Mg] / Plan extraction [Mg] × 100%	mining plan 3 227 391 Mg	95–100%	Month	Deputy Head of Mining Works, Head of Mining Works (TG-1)
Calorific value of fine raw	Achieved average calorific value of fine raw [kJ/kg] / The planned caloric content of fine raw [kJ/kg] × 100%	The planned caloric content of fine raw 19 427 kJ/kg	90–100%	Month	Head of Quality (HKJ)
Stops haulage (failures)	Dwell time haulage [min]	Average waiting time in the month of haulage 0 min/month	0 min/month 60 min/month	Month	Deputy Head of Ener-gomechanics, Chief Me-chanic for the Pit (MM)
Stops the skip (failures)	The skip stopping time [min]	Average time stop-ping the skip a month 0 min/month	0 min/month 60 min/month	Month	Deputy Head of Energo-mechanics, Chief Me-chanic for the Pit (MM)
Overall efficiency in the coal trade	The yield total [kg/ED] / Planned total yield [kg/ED] × 100%	The planned total yield 3770 kg/ED	95–100%	Month	Chief Specialist Head of Budgeting (DB)
The intensity of preparatory works	Number of preparatory works for the extraction of [mb/1000 Mg]	4.4 mb/1000 Mg	4.0 mb/1000 Mg 5.0 mb/1000 Mg	Month	Chief Specialist Head of Budgeting (DB)

- Quality control of coal on piles:
  - of sampling and preparation for chemical analysis in accordance with the PN-90/G-04502;
  - determination of the basic parameters of coal in stationary ash probe.
- Releasing the finished product for shipment.
- Documenting the analysis of the results ob-tained.
- Preparation of accounts coal quality: of fixing carbon classes at secondary settlements based on the results of analyzes chemical of registration, checking accounts (tonnage, grade, price), prep-aration of documentation.
- Issuing certificates of quality coal for domestic and export recipients.
- Quality control of raw coal by: of execution and preparation of analyzes and mineral samples according to PN/G-04501, analysis of the per-formance of the feed-targeted processing plant, about the performance of the sieve analysis of raw coal, perform analysis of densimetric (Chapter dioxide in heavy liquid).
- Recording quality parameters of raw fines in the e-RDJ.
- Quality control of products of various techno-logical processes: of performing "tests speed events" content of concentrate and hypertrophy in the waste, of performing "tests speed events" waste content and hypertrophy concentrate, sieve analysis of the process for classification, sampling of products from different technology nodes.
- Develop and update the current offer quality production.
- Supervision and permanent control of ash probe and other devices that are in stock Branch.
- Supervision of the performance of services by foreign companies in the field of tangible on the Branch.

- Develop a schedule sampling of commercial coal, and the framework of daily work schedule Coal Quality Control Department.
- Develop in cooperation with the Department of Mechanical Coal schedule sampling technology to the processing plant.
- Compilation of statistics departmental and state. The tasks include the Department of Laboratory while the following activities:
- Determination of quality parameters: of carbon trading of the raw coal, of interoperable products and product enrichment, of carbon board samples.
- Perform analysis of fine sieve.
- Perform analysis related to the control of the circulation of water – sludge processing plant.
- Archiving of coal samples.
- Perform analysis of gas, oil, water and other outsourced by the external departments.
- Provide documentation of analytical results.
- Supervision of the correct operation of measuring devices – the research involved in the implementation of indications: for monitoring and documenting of devices using standards and reference materials, of records conducted legalization and calibrations.

Indicators of the quality of raw coal production in 2006–2010

In this publication, due to the way accounting data are indicators of the system two years – every two years – in 2006, 2008, 2010. Table 2 presents selected indicators on the efficiency of the production process of raw coal. As follows from the data obtained, we can conclude that all the indicators are defined in the criterion of effectiveness. It can, therefore be concluded that the first of which is studied processes raw coal production has a beneficial effect on the functioning of the quality management system in the enterprise, because it does not produce any loss.

Indicators on the production of raw coal in 2008 are presented in table 3. The values suggest that performance indicators are the norm, that is acceptable criterion of effectiveness is also preserved. If the criterion of effectiveness has been preserved, it also means that the expected value is reached among other by the pointer implementation of preparatory works in general. From the data collected in the array can also be inferred that the rate of which is the total production decreased compared to 2006, and the yield per employee increased. Other

Table 2. Process indicators: Production of raw coal in the year 2006 [23]

Symbol and the name of the process	Definition of Indicator	The expected value	The criterion of effectiveness (value limit indicator)	Realisation	Non-relative deviation
PWS Production of raw coal	Implementation of preparatory works in total [m/m]	100%	95–100%	100	0
	Charging time [days]	42 days	90–100%	42	0
	Time of liquidation of wall [days]	42 days	90–100%	42	0
	Extraction of total [Mg/Mg]	100% 3 227 391	95–100%	3 227 391	0
	Stability worth. calorific fine raw [kJ/kg]	19 427 kJ/kg	90–100%	19 612	185
	Stops haulage (failures) [min/day]	6 min	0–6 min	6.0	0
	Stops the skip (failures) [min/day]	0 min	0–6 min	0	0
	Avg. Productivity per employee [tons/empl.]	828 t/employee.	90–100%	783.2	45.4

Table 3. Process indicators: Production of raw coal in 2008 [23]

Symbol and the name of the process	Definition of Indicator	The expected value	The criterion of effectiveness (value limit indicator)	Realisation	Non-relative deviation
PWS Production of raw coal	Implementation of preparatory works in total [m/m]	100%	95–100%	103	3
	Charging time [days]	42 days	90–100%	42	0
	Time of liquidation of wall [days]	42 days	90–100%	42	0
	Extraction of total [Mg/Mg]	100% 3 227 391	95–100%	3 074 541	152 850
	Stability worth. calorific fine raw [kJ/kg]	19 427 kJ/kg	90–100%	19 143	216
	Stops haulage (failures) [min/day]	0 min	0–6 min	0	0
	Stops the skip (failures) [min/day]	2 min	0–6 min	2	0
	Avg. Productivity per employee [tons/empl.]	858 t/ employee.	90–100%	811	47.0

Table 4. Process indicators: Production of raw coal in 2010 [23]

Symbol and the name of the process	Definition of Indicator	The expected value	The criterion of effectiveness (value limit indicator)	Realisation	Non-relative deviation
PWS Production of raw coal	Implementation of preparatory works in total [m/m]	100%	95–100%	110	3
	Charging time [days]	42 days	90–100%	42	0
	Time of liquidation of wall [days]	42 days	90–100%	42	0
	Extraction of total [Mg/Mg]	100% 3 227 391	95–100%	3 229051	0
	Stability worth. calorific fine raw [kJ/kg]	19 427 kJ/kg	90–100%	19 296	131
	Stops haulage (failures) [min/day]	0 min	0–6 min	0	0
	Stops the skip (failures) [min day]	1 min	0–6 min	1	0
	Avg. Productivity per employee [tons/empl.]	858 t/ employee.	90–100%	826.7	31.3

indicators remain unchanged. Data obtained from the indicators management system in the production of raw coal for the year 2010 (Table 4) show a large increase in the indicators, as shown by the indicator which is the realization of preparatory work, the average productivity per employee or total production.

Discussed comparing values to the values of previous years can be concluded that the quality management system achieves its objectives by achieving ever expected value ratios and better functioning, which translates into overall enterprise management system.

Analyzing data on the production of raw coal collected in tables 2–4 presents a comparison of selected indicators of the quality management system relating to this area, along with the expected value, which is determined for each indicator of the quality management system.

Figure 2 shows the ratio for the production of raw coal, which is the implementation of preparatory works in general. The expected value of this ratio is 100%. As the analysis shows, this ratio has always been in compliance with the required standards and even exceed the expected value, which is beneficial for the production process of raw coal.

Another considered an indicator of the production process is the extraction of raw coal in total, the expected value is 3 227 391 [Mg/Mg]. Analyzing the results of the comparison are presented in figure 3, in 2008 there was a clear decline in production, while in other years studied mining remained at the level of the expected value which was 100% and more.

The last of the indicators examined the production of raw coal is the average productivity per employee whose expected value is 858 [tonnes / empl.]. A comparative analysis of all three years shown in figure 4, showed an increase in this ratio, reaching 96.35% in 2010.

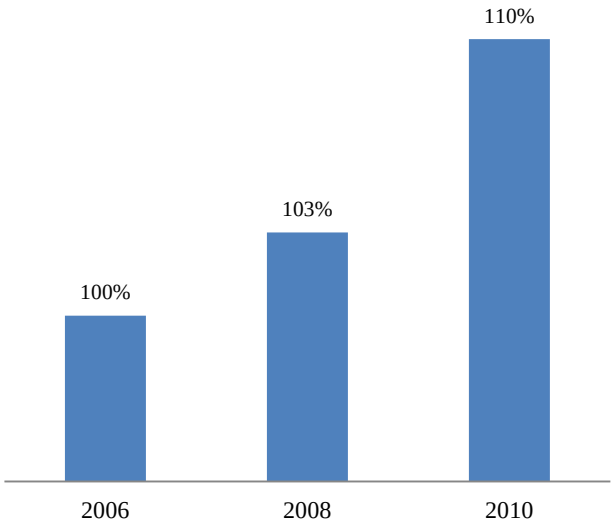

Fig. 2. To compare the preparatory works of the total expected value (degree of achievement of the objectives in%) (own study on basis [23])

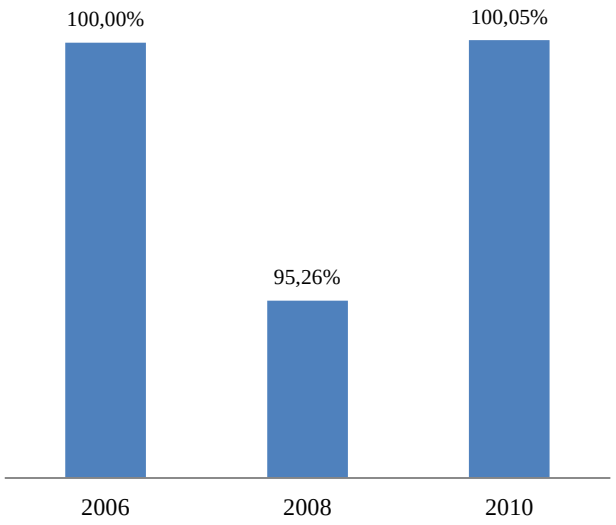

Fig. 3. Comparison of the total production of the expected value (degree of achievement of the objectives in%) (own study on basis [23])

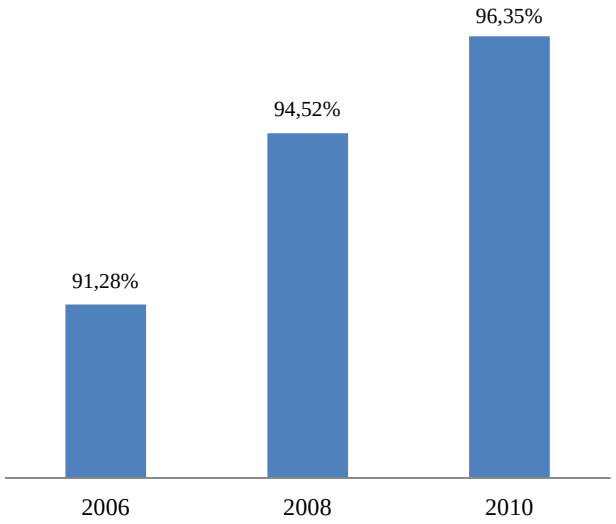

Fig. 4. Comparison of the average productivity per employee with the expected value (degree of achievement of the objectives in%) (own work on basis [23])

Conclusions

The data obtained at the end of the surveyed years 2006–2010 showed various types of fluctuations to the quality management system, while overall, in 2010, has significantly improved the functioning of the quality management system, and thus it can be concluded that it is effective. Companies with good results in 2010 achieved its stated objectives, as most of the indicators of effectiveness of quality management system has achieved the expected value.

Effectiveness of the quality management system KWK Chwałowice, can be seen through, inter alia, rate of extraction of coal, as the company has production in line with the expected norm, which translates into profitability and competitiveness. Quality means the caloric content, which is one of the indicators of the production process to give the commercial coal over the years increasingly higher values, and thus achieves the objectives set.

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