



Process Management in Hard Coal Mining Companies

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Abstract

The article presents one of the most commonly used approaches to management, namely process approach and process management. This problem is quite complex due to the number of processes carried out by hard coal mining enterprises. The classification of processes according to three categories such as: management processes, core processes and supporting processes is discussed. Attention is paid to the efficiency and effectiveness of the process and the measures used to manage these processes.

The cognitive goal of this article was to gain knowledge about the use of process management in hard coal mining enterprises. The aspects selected by the authors concerned the analysis of the processes carried out by these enterprises. In particular, the process of Occupational Health and Safety (OHS) Management and “Environmental Protection” (EP) has been analyzed. Their input and output elements are presented, as well as exemplary measures of their effectiveness.

Keywords: management, processes, mining companies, performance measures

Introduction

Process management is, nowadays, becoming an increasingly developed concept in organisation management. It still is of substantial interest to managerial staff, which results from earlier management problems, described, i.a., in *The State of Business Process Management 2014* by P. Harmon and C. Wolf. They presented the results of studies on business process management worldwide and demonstrated that, since 2005, organisations had most often used counselling and support of external consultants in defining the relations between the strategy and processes (Harmon, Wolf, 2014). This problem is quite an important one, as every year almost half the surveyed enterprises cannot cope with it (40%–47%), some expect consultants to provide support in developing the process architecture of the organisation (36%–45%), developing the result measurement system (35%–41%) and coordinating and managing Business Process Management (BPM) projects and programmes (33%–37%). The issue in question is much more complex in such specific enterprises as mining companies.

This article focuses largely on presenting the selected elements of the process approach in mining companies and the processes implemented by them.

Process management concepts

Many new concepts of management have been developed in recent years, which was caused by the quickly evolving market conditions, strong competition and the organisations’ willingness to meet custom-

er expectations under such market conditions (Trocki, 2012). Such a situation forced mining companies to search for and use tools which would support them in more efficient and effective management, and especially facilitate the improvement of the processes taking place within. The process approach and process management are currently among the most commonly used approaches to management. According to S. Nowosielski, the process approach is considered the most important orientation in organisation and management (Nowosielski, 2009), while J. Czekaj argues that it is becoming a paradigm in management (Czekaj, 2009). More and more entities are striving for improvement through reengineering, kaizen and benchmarking. As stated by G. Jokiel, “process management is a broader concept, more mature, and adapted not only to the times of revolutionary changes, but also to the evolutionary development of an organisation” [(Nowosielski, 2009). Therefore, the methods and concepts of process management also include: Activity Based Costing (ABC), Activity Based Management (ABM), Balanced Scorecard (BSC), Just-in-Time (JIT), Kanban, as well as Lean Management (LM) and Total Quality Management (TQM).

The process approach in mining companies and the implemented processes

In the mining industry, a process is understood in general terms as a set of interconnected or interacting actions, which transform inputs into results. All activities consist in performing specific tasks using specific

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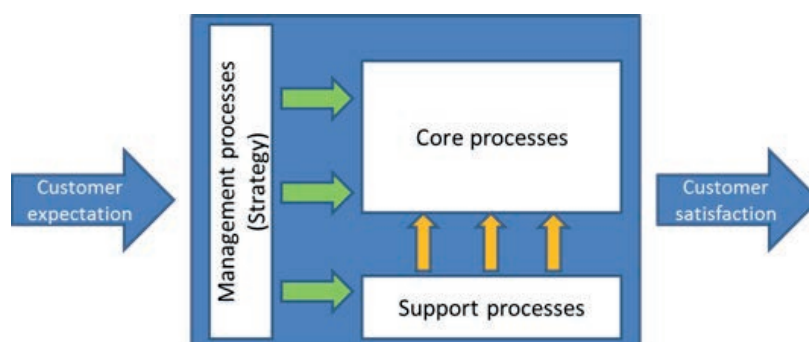


Fig. 1. Processes in a mining company, Own elaboration
 Rys. 1. Procesy w przedsiębiorstwie górniczym, Źródło: Opracowanie własne

Tab. 1. Model processes carried out in hard coal mines. Source: own elaboration on the basis of (Stefaniak, Parysiewicz, 2006)
 Tab. 1. Przykładowe procesy realizowane w kopalniach węgla kamiennego

Process type	Process name
Management processes	technical and economic planning HRM internal and external communication management system improvement mine strategy
Core processes	customer requirement identification planning production planning opening work preparatory work reinforcement work removal work output transport vertical transport agglomeration of coal forwarding
Support processes	data analysis horizontal transport working environment equipment supervision

resources, and aim at reaching their objective. More specifically, coal process is a specific process which is of an extraction and processing nature. As a result of the activities forming the process of extracting the mineral from a rock mass, the final product – hard coal, is obtained, which subsequently needs to be adjusted to the requirements of customers. Due to the specificity of its operation and the complexity of tasks to be performed in the entire coal extraction process, each mining company deals with processes management.

The processes implemented in the mining industry can be classified into three categories (Karkula, Kowal, 2012). These are (Fig.1):

- management processes,
- core processes,
- support processes.

Core processes include the engineering processes characteristic of extraction and processing. They are assisted by support processes, designed to ensure the continuity of the core processes. The entirety is strapped together by management processes which aim at the correct implementation of the mine's strategy.

Management processes control all the business processes in the mine. Their objective is to correctly implement the mine's strategy. These processes include technical and economic planning, personnel management, and management system review and improvement. Management processes are also oriented at the continuous improvement of communication, These activities are aimed at streamlining the information flow between the mining company's management levels (head office – mine and inside the mine), as well as other units (departments) outside the mine.

Sub-processes are performed within each of the three process categories. The core processes in the mining industry include engineering processes characteristic of extraction and processing, which include opening work, preparatory work, reinforcement and removal work, extraction work, output haulage, vertical transport, transport of staff, ventilation, drainage, energy supply, processing and other processes.

Core processes are reinforced by support processes, designed to maintain / ensure the continuity of core processes. They consist in, among other things, analysis of the necessary data, ongoing supervision of mea-

Tab. 2. The input and output data for the OHS process. Source: Own elaboration on the basis of Quality Manual sections in a model mining company
 Tab. 2. Dane wejściowe i wyjściowe Procesu BHP

Input elements	IMS policy Legal requirements for OHS Requirements of the internal acts of Kompania Węglowa S.A. Hazards in the organisation Analysis of occupational health and safety in the organisation Results of the measurement of harmful factors in the working environment Results of the analysis of root causes of accidents at work and occupational diseases Results of the controls/inspections of working conditions by supervisory authorities Reports on the conducted internal controls and reviews by the Social Labour Inspection Results of internal and external audits Deposit management project Geological and hydrogeological documentation of the deposit Technical documentation Mining work schedules
Output elements	OHS objectives and specific tasks; Approved OHS improvement scheme Occupational risk assessment for the position and in the workplace accepting the lowest possible level of occupational risk Knowledge of the identified risks, including identification of particularly hazardous work Current and available OHS instructions (general and on-the-job), including the performance of particularly hazardous work Machines adapted to occupational safety equipment Results of the analyses of root causes of accidents at work and occupational diseases Emergency and/or accident preparedness at work

Tab. 3. Model measures of OHS process effectiveness. Source: Own elaboration on the basis of the Process Manual of a model mining company
 Tab. 3. Przykładowe mierniki skuteczności procesu BHP

Name	Measure definition	Expected value	Effectiveness criterion	Measurement frequency	Person responsible for monitoring
Accident frequency rate per 1000 employees	number of accidents at work in the analysed period [pcs.]/ number of employees (as at the end of the analysed period) [pcs.] x 1000	11	From 90% To 110%	year	OHS Management Coordinator
Accident seriousness index	number of days of incapacity for work as a result of an accident at work [pcs.]/ number of accidents at work (excluding fatal accidents) [pcs.]	68	From 80% To 120%	year	OHS Management Coordinator
OHS expenditures index per employee or tonne of output	expenditures incurred in relation to the implementation of the OHS improvement scheme in the analysed period [PLN]/ extraction in the analysed period	More than PLN 14 per Mg	From PLN 12.0 per Mg	year	OHS Management Coordinator

surement equipment and the working environment of miners (underground employees). They also include the vertical transport, i.e. from around the wall or face, towards the shaft, of employees and output.

The implementation of process management in mining companies results, first and foremost, from:

- the implementation of an integrated management system,
- striving to improve quality (to offer products expected by the customer),
- striving to improve the company's operational effectiveness,
- willingness to streamline and rationalise the course of internal processes.

Mining companies, by following changes in the management systems of market enterprises and introducing the process approach, wanted to create an image of a company which cares for the environment (meeting ISO standards) and its employees, mainly by improving occupational safety and health conditions. Therefore, the aforementioned characteristics of the process approach match those proposed by A. Bitkowska (Bitkowska, 2013).

It is worth noting that one of the fundamental elements of effective management of hard coal mining companies in Poland is to first become acquainted with the key business processes and then to determine the set of financial and non-financial measures related to the processes and facilitating their measurement. On

Tab. 4. Input and output data for the Environmental Protection process. Source: Own elaboration on the basis Quality Manual sections in a model mining company

Tab. 4. Dane wejściowe i wyjściowe Procesu ochrona środowiska

Input elements	<ol style="list-style-type: none"> 1. Identified environmental impact: <ul style="list-style-type: none"> - surface degradation, - waste generation, - resource consumption, - air, water and soil pollution, - noise emission 2. Legal and other requirements: <ul style="list-style-type: none"> - acts, - regulations, - decisions and permits of public administration and supervisory bodies - operational control and on-the-job instructions, - internal legal acts, - utility supply, material and service supply, and waste and sewage collection agreements. 3. Guidelines of the head office of the mining company 4. Strategic environmental objectives adopted by the head office of the mining company <p>Stakeholder's remarks</p>
Output elements	<ol style="list-style-type: none"> 1. Environmental impact assessment 2. Limiting negative environmental impacts – reducing the nuisance of negative environmental aspects 3. Assessment of conformity with legal and other requirements 4. Meeting legal requirements 5. Implementation of strategic environmental objectives by implementing appropriate environmental programmes 6. Taking measures in cases submitted by stakeholders <p>Evaluating the effectiveness of the Environmental Management process</p>

the other hand, Key Performance Indicators, allow for an objective measurement of their results. So-called effectiveness and efficiency measures, which are inter-related, are used to efficiently and effectively manage processes (Szczepańska, Bugdol, 2016). Effectiveness measures determine the extent to which the analysed process does what has been planned. Quantity and punctuality are the two main aspects used. For efficiency measures, efficiency is determined by the degree of resource utilisation.

Every process carried out in a mining company has:

- a process owner, i.e. the person responsible for the course and completion of the entire process, and the supervision and monitoring of process measures,
- process objective and scope, what it is used for and how it should be carried out,
- input and output data for the process,
- the aforementioned process measures.

The management of model processes in mining companies

Processes constitute a logical string of interconnected actions, which transform the input state into the output state. In order to facilitate an objective analysis and the evaluation of effectiveness and efficiency of processes, objectives are parameterised, determining qualitative measures of their implementation. The measures and indicators of every process are described in the Process Manual, the Technical and Economic Plan, the strategy of a given mining company and in other documents. In addition, procedures are determined within every process, which constitute its more precise elements. They present the manner and order of actions performed within the process.

For the purposes of this article, two processes are presented: Occupational Health and Safety (OHS) Management and Environmental Protection (EP). Both these processes are within the group of management processes implemented by the mining company.

The primary objective of the OHS process is to ensure safe and healthy working conditions. This is achieved by optimising the work of OHS services and supervision of workstations, identifying hazards and preventing accidents and emergencies, ensuring effective operation of machines and devices and presenting the results of occupational hazards assessment. The input and output elements for the OHS process are presented in Table 2.

The effectiveness of the OHS process is measured, i.a., by the accident frequency rate per 1000 employees, the accident seriousness index, OHS expenditures index per employee or tonne of output. Model measures are presented in Table 3.

One crucial task of the EP process is to identify, monitor and analyse environmental aspects in order to supervise the impact of activities on the environment and ensure compliance with the legal environmental protection requirements in force. The process makes it possible to improve environmental performance through the planning and development of environmental programmes, as well as preparedness and response to environmental emergencies and proper environmental impact reporting. The input and output elements for the EP process are presented in Table 4.

As regards Environmental Protection, process effectiveness is measured by, e.g. implementation of environmental programmes, the underground water discharge index and the extractive waste generation index. Model measures are presented in Table 5.

Tab. 5. Model measures of Environmental Protection process effectiveness. Source: Own elaboration on the basis of the Process Manual of a model mining company

Tab. 5. Przykładowe mierniki skuteczności Procesu Ochrony Środowiska

Name	Measure definition	Expected value	Effectiveness criterion	Measurement frequency	Person responsible for monitoring
Implementation of environmental programmes	Number of tasks completed within environmental programmes [pcs.]/Number of tasks planned in a given period of time [pcs.] x 100%	100 % of the tasks planned within environmental programmes in a given year 4 pcs.	From 80% to 100%	quarter	Environmental Management Coordinator
Underground water discharge index	Volume of underground water discharged to surface streams [m ³ /d]/ Volume of underground water indicated in a water permit Q _{max} [m ³ /d] x 100%	less than 100%	From 0% to 100%	month	Environmental Management Coordinator
Extractive waste generation index	Total volume of extractive waste generated Volume of extractive waste specified in the extractive waste management programme x 100%	less than 100%	From 0% to 100%	year	<i>Environmental Management Coordinator</i>

Conclusion

The extractive activity of mining companies consists of a number of processes, which often interweave and complete one another. Managing all processes is incredibly important, but also very difficult. Due to their complexity it is important to determine the interrelations between individual processes to facilitate their integration and matching, so as to achieve maximum value added and customer satisfaction, but externally and internally [9]. One may say that the carried out processes are analysed and improved to (Kwieciński, 2014):

- improve customer satisfaction (core processes),
- optimise costs (support processes),
- improve efficiency and effectiveness (management processes).

The formal objective of every process is to unify the procedure and document the activities conducted throughout the entire mining company. Improvements in the management of mining companies and meeting

the requirements of the Integrated Management System are effected through the process approach. Every process should be skilfully managed and demonstrate, on the one hand, effectiveness (ability to achieve the set goals) and, on the other hand, efficiency (the relationship between results and resources used). According to R.S. Kaplan and D.P. Nortom, one can manage that which can be measured. It is, therefore, necessary to monitor and analyse the level of the indicators assigned to each process and react in due time should their values differ significantly from the expected, planned values. Quick response to changes in a complex and constantly changing environment can help to increase the competitiveness of mining companies.

The processes showed in the article indicate that hard coal mining companies use process management in their activities.

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Zarządzanie procesowe w przedsiębiorstwach górniczych węgla kamiennego

W artykule przybliżono jedno z obecnie najczęściej stosowanych podejść do zarządzania, mianowicie podejście procesowe i zarządzanie procesami. W przypadku przedsiębiorstw górniczych węgla kamiennego problem ten jest dość złożony ze względu na ilość realizowanych przez nie procesów. Omówiono klasyfikację procesów według trzech kategorii: procesów zarządczych, procesów podstawowych i procesów wspomagających. Zwrócono uwagę na skuteczność oraz efektywność procesu oraz stosowane miary, poprzez które można zarządzać procesami.

Celem poznawczym niniejszego artykułu było zdobycie wiedzy na temat wykorzystywania zarządzania procesowego w przedsiębiorstwach górniczych węgla kamiennego. Wybrane przez autorów aspekty dotyczyły analizy realizowanych przez wspomniane przedsiębiorstwa procesów. Przyglądnięto się w szczególności procesowi Zarządzania Bezpieczeństwem i Higieną Pracy (BHP) oraz Ochronie Środowiska (OS). Przedstawiono ich elementy wejścia i wyjścia, a także wskazano przykładowe mierniki ich skuteczności.

Słowa kluczowe: zarządzanie, procesy, przedsiębiorstwa górnicze, mierniki skuteczności